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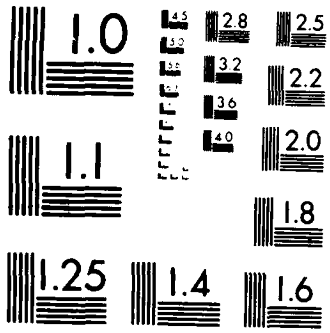
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THE OHIO STATE UNIVERSITY

CIMAG2

THE COMPUTER PROGRAM TO GENERATE COLOR IMAGES

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16. Abstract (Limit: 200 words)

This report describes a user interactive FORTRAN program, CIMAG2, to be used to produce color images using either measured or calculated scattered field data. The program provides the processing of either the frequency or time domain data, and produces a 2-D image of the target of interest. Color plots of the images are done by another program called CLRPL which can also be accessed while running CIMAG2. The report includes the user's and programming manuals, a listing of the commands in the 'HELP' library and all the FORTRAN subroutines.

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I. INTRODUCTION

CIMAG2 is a user interactive FORTRAN program which can be used to produce the color images of the targets using either measured or simulated scattered field data. The program is also capable of processing either frequency or time domain data prior to the image processing.

The original version of the program is written by Dr. J. Young and the new version is written and modified by S. Smithberger and G. Dural. An access for the 'file read' routines of the program 'FTRAN' [1] is provided for the users who already processed their data by FTRAN.

Color images are displayed on a Tektronix 429 color CRT display and hard copy unit via the computer program CLRPL (Appendix D). CIMAG2 accesses the program CLRPL via the 'DCL commands' facility of the program.

Theory related to the imaging procedure is described in detail in another report entitled "Polarimetric ISAR Imaging Using Either Measured or Calculated Transient Signatures" [2].

Chapter II contains the User's Manual of the program. The Programmer's Manual is included in Chapter III. Chapter IV covers the conclusions. Program listings and a list for the 'HELP' library are contained in the appendices.

II. CIMAG2 USER'S MANUAL

This manual shows the user how to use the CIMAG2 program. It can be read in bits and pieces as the user finds a need for information but it is recommended that the user take the time to sit down and read all of the information given here. CIMAG2 is a very sophisticated program into which a lot of automation has been installed. The basic routines can be used to get perfectly usable image, but the user will be able to handle more data more efficiently if he takes the time to learn the automatic features of the program. Not only will he save time in generating the images but he will also find it easier to keep track of what he has done. It is also recommended that the user read this manual while sitting in front of a terminal in order to get a better grasp and feel for what is going on. There are many examples of command sequences in this manual which can be used for illustrative purposes.

This manual stresses processes in which a series of commands have to be used rather than the individual commands themselves. If the user needs more information about the commands available, he can do the following:

- get into the program by typing
  $RUN user2:[DURAL.CIMAG2]CIMAG2

- type the command
  <>HELP

At this point the computer will list a menu of commands used by the CIMAG2 program. The user simply types the command that he is interested in and the computer will give him the information that he seeks. When he is finished he simply keeps hitting the <RETURN> until he gets back

to the '<>' prompt. This command is most useful when one is in the middle of doing something and can't remember what a command is called or can't remember what a certain command does.

2.1 PUTTING THE DATA TOGETHER

2.1.1 Appending Data Files

Some of the data used by the CIMAG2 program will come in chunks. In other words, sometimes the data for a given look angle couldn't be taken all at once so it was necessary to make more than one data file in order to get all the available data. If we want to use all of the data that is available or at least more than one data file for a given look angle then we will have to append the data files together. This seems simple enough since a given element of the array is assigned a certain frequency. However, many times the files may overlap. One file may contain data from 1.5-6.5 GHz and the other may contain data from 6-12 GHz. When we put the two files together we don't want the overlapping part of the files to add up so we will have to use what is called the FGT command which puts a trapezoidal gate around the information that we are trying to get to and in effect chops off the information that we don't want. After the files have been properly gated then we will use the COM (combine) command to put the files together. The following is a general procedure for putting two files together. The text following the exclamation points are comments to inform the reader what is going on. The exclamation marks and comments are not to be typed into the program.

```
<>RDFL                               ! A frequency domain read command
...                                  !  This command will be covered in
                                     !  the following sections.
<>SBF                                ! The store in buffer command
  BUFFER # 1
<>RDFL
...
<>SBF
  BUFFER # 2

                                     ! A good way of deciding which
                                     ! elements of the array should
                                     ! be modified is through the use
                                     ! use of the TYP command.  This
                                     ! command will list any range
                                     ! of the array elements and
                                     ! their respective values.

<>RB1                                ! Put the contents of buffer 1 in
                                     !  the main buffer.
<>FGT                                ! This is the gating command
  HARMONIC FOR START OF HIGH FREQUENCY CUTOFF ! The array element
        598                                   !  where the cutoff
                                              !  begins.
  HIGH FREQUENCY ROLL-OFF IN DB PER HARMONIC  ! This is quite a
        50.0                                  !  bit since we
                                              !  want
                                              !  a sharp cutoff.
  HARMONIC FOR START OF LOW FREQUENCY CUTOFF  ! This element is
        1                                     !  in the region
                                              !  that is never
                                              !  used close
                                              !  to DC.
  LOW FREQ ROLLOFF IN DB PER HARMONIC ! A very slow roll-off
        0.01
<>SB3                                ! It is stored in buffer 3 in so
                                     !  that if an error was made we
                                     !  can try again.

                                     ! We will use the combine command
                                     !  to put the two files together
                                     !  but the files have to be
                                     !  converted to the time domain
                                     !  before we can do that.
<>RB2
<>IFF                                ! Inverse Fast Fourier transform
                                     !  does this conversion.
<>SB4
<>RB3
<>IFF
<>SB5
```

```
<>COM
  STORAGE BUFFER NUMBER(USE 0 TO FINISH): 4   ! Combine the two
  MULTIPLIER =  1.0                           !  files.
  STORAGE BUFFER NUMBER(USE 0 TO FINISH): 5
  MULTIPLIER =  1.0
  STORAGE BUFFER NUMBER(USE 0 TO FINISH): 0   ! A "0" means we're
                                              !  finished.
                                ! At this point it is recommended
                                !  to plot the waveform and see
                                !  whether it is continuous.  We
                                !  don't want a spike or null to
                                !  occur at the point we combine
                                !  two files.
<>SB6

                                ! At this point we should check
                                !  the frequency domain again to
                                !  make sure we did the gating
                                !  right.
                                !  If data overlapped then there
                                !  will be a spike where the two
                                !  files were joined.  If there
                                !  was a hole left in the data
                                !  then a null will appear where
                                !  the two files were joined.

<>RB6
<>FFT                           ! Fast Fourier Transform converts
                                !  the time domain back to the
                                !  frequency domain.
<>SB7
..
 <>RB6
<>WRI                           ! This command is pretty well
...                             !  self explanatory.
```

2.1.2 Processing Routines Now In Use

These are the processes that are currently being used on the data before an image is generated.

2.1.2.1 Read Commands

There are four read commands of the two types of reads to be performed by this program. The data that is taken from the radar range is stored in a frequency domain format. This is the raw data. For imaging purposes we will be using the (filtered) time domain waveform. CIMAG2 can only store time domain waveforms. Most of the time the user will process a frequency domain waveform, multiply it with frequency transform it to the time domain, and then store it. Later we will come back and read in several of these time domain waveforms and use them to make an image. With this procedure in mind we will now explain the four read commands -- two of which (FTREA,FFREA) are used to read the files processed by FTRAN [1].

RDFL Frequency Domain Read

The RDFL command was designed to read in the calibrated frequency domain files from the ESL database. The following are questions the that the program will ask and what they mean to the user:

```
FREQUENCY SAMPLING(1) OR .1KL SAMPLING(0)?
FREQUENCY INCREMENT IN MHZ
```

If the user chooses to use frequency sampling then the program will ask for the frequency increment to be used for each sample.

```
INPUT MAJOR AXIS DIMENSION IN INCHES
```

If the user chooses to use .1KL sampling then CIMAG2 will ask this question.

```
SELECT THE TYPE OF INTERPOLATION
INPUT 0 --> TWO-POINT INTERPOLATION ; NO SMOOTHING
INPUT 1 --> INTERPOLATION AND SMOOTHING USING A COSINE WINDOW
```

Most of the time there will be no need for smoothing since the user will more than likely be using data that has already been calibrated. Usually the data is smoothed in the calibration phase but if the data has not been sufficiently smoothed, then the facilities are here to do more smoothing.

```
 ASSUMED INPUT AMPLITUDE IS IN DB/SQUARE CM
 NORMALIZE TO: SQ CM(1),SQ M(2),PI*L*L/4(0)?
```

```
TYPE DATA FILE NAME
```

This is obviously the file name of the data. If the data file is not in the current directory be sure to fully specify the file name. The program will then type out the header of the file so that the user can be sure he has the right file.

REA Time Domain Read

The REA command is a much simpler command. It simply asks for the file name and then types out the header. This command is only intended to read files that were output from the CIMAG2 program therefore it has been taken for granted that the file was stored in whatever form it was needed. However, the file can be processed more after it has been read in.

FTREA or FFREA

These are the time and Frequency domain read commands for the files processed by the program FTRAN [1]. Since FTRAN is capable of reading either 750 or 11/23 type data, the user must be careful about the format of the data file. Default is 11/23. The FTY command can be used to switch from one format to another.

FTY

To control the format of the data file the user should type the command FTY. The program then will ask about the file type. Enter T for 750, and F for 11/23 type. Default is 11/23 type when the program is started unless no FTY command is used then.

2.1.2.2 IFF Inverse Fourier Transform

The INVERSE FOURIER TRANSFORM command converts a data file from the frequency domain to the time domain. This command

must be performed before the file can be used for an image and before the file can be output using the WRI command.

2.1.2.3 ROT Rotate

The ROTATE command takes all the elements of a time domain file and moves them either in the positive direction or the negative direction. When an Inverse Fourier Transform is used to convert a waveform from the frequency domain to the time domain a waveform is created which repeats throughout time. The 4096 element array is in effect a time window which shows one complete iteration of this waveform. The main pulse of a time domain waveform may occur around the zero time position. When this happens part of the pulse will be plotted at the beginning of the plot and part of the pulse will be plotted at the end of the plot. Using this command we can move the pulse to some other part of the plot (usually to element 1024) so that the entire pulse can be plotted in one area of the plot.

2.1.2.4 WND Windowing

The frequency domain files that we are using for data are band limited. On either side of the valid data that lies within this bandwidth is a null value. This creates a very sharp change in the amplitude of the waveform where the data starts and ends. The technique of Fourier Transform assumes that the frequency domain waveform is continuous. The sharp changes in the data file are very discontinuous. Thus when these discontinuities are

transformed into the time domain they cause an oscillation of the time domain waveform. The WINDOW command reduces this problem by convolving the frequency domain waveform with a cosine. This greatly reduces the change in amplitude that occurs at the beginning and the end of the valid data thereby reducing the oscillation that results in the time domain.

2.1.2.5 DCV Downconversion

Since the bandwidth of the data that we are using lies in a region well above DC, many of the resulting time domain waveforms take the appearance of a modulated waveform much like that received from a radio station. To get rid of this effect we are currently doing just what the radio receivers do: move the center of the bandwidth to DC. That is what the DOWNCONVERT command does. It respond with the number that represents the middle of the bandwidth.

eg. :

If we are using a bandwidth of 1-12 GHz, then the center of the bandwidth is 6.5 GHz. ((12-1)/2 +1) This corresponds to element 650.

2.1.2.6 MJW Multiply by jw

Multiplying by jw in the frequency domain is the same as differentiation in the time domain. Another way of thinking of it is to say that it will shift the phase of the waveform ninety

degrees and act as a high pass filter. One can see that the higher the frequency the higher the amplitude.

2.1.2.7 MVR Multiply by w

This command is used as a high pass filter. The higher the frequency is the the bigger the multiplying factor will be. It is a required step in data processing with the algorithm described in [2].

2.1.2.8 WRI Write

The WRITE command is the only way to output a file. Many times after the user has processed a file he will want to save it. Then when he wants to use it again he simply reads it in and the file can be used in a pre-processed form. This command can only write out time domain files so somewhere along the line the file will have had to been transformed using the IFF command. If the user wishes to save the file and then later when he reads it in perform some more processing in the frequency domain, he simply reads it in in the time domain and then performs a FFT command which will convert it back to the frequency domain.

2.1.3 Summary Of Data Processing

Here is the sequence of commands that we are currently using to process the data:

```
1 RDFL
        - frequency sampling every ten degrees
            (Different sampling intervals
              can be used to scale the
              image.)
        - no smoothing
        - normalized to square meters

2 WND
        - use a Hanning Window

3 MWR

4 DCV

5 IFF

6 ROT   (Optional)
        - usually by 1024

7 WRI
```

2.2 PROCEDURE DEFINITIONS

2.2.1 What Are Procedure Definitions?

Most of the time when an image is made many data files will be needed. This means that many data files will have to be processed using the same command sequences with the same parameters. This is time consuming, redundant, costly, and bothersome. CIMAG2 has a way to get around this problem. A procedure definition is a series of commands that are to be performed on a number of data files. It will take a list of input files and a list of output files, process each file and then put the results in the corresponding output file. This allows the user to go through the procedure once and then let the computer do all the work.

2.2.2 How to Use the PROC Command

The PROC command is a very powerful command but the user must take great care in using it. It is a good idea to go through the first data file the regular way to make sure the method of data processing gives the results that you are looking for. Then you can go ahead and define a procedure with an input list and an output list.

COMPARE THE RESULTS WITH THE FILE MADE THE REGULAR WAY
TO MAKE SURE THE PROCEDURE IS DOING WHAT YOU THINK IT IS DOING!!

It is very possible to think you have defined one thing when in fact you have defined something else. This may take some time but not as much time as processing all the files manually or redoing an image because you have used data that is trash.

Let's say that you have already done the test case and you know the exact sequence of commands that you want to perform on each data file. This is the sequence of events that will occur when you define the procedure:

```
<>PROC


Do you have a procedure definition file

for this process already?(Y or N)


        ! If you answer this question with a Y then you
        !   will be asked for a filename.  If you answer
        !   N then you will be given the following prompt.

Enter the process using regular commands and
NAME.DAT for a filename. For the new
filename use NEWNAME.DAT. When finished
defining the process use the command DONE.
        (Warning: a filename must be listed for
                each time it is used.)


        ! At this point the user will type in something that
        !  looks like the following.  Notice how the filenames
        !  NAME.DAT and NEWNAME.DAT have been used.  The lines
        !  that the user input have been marked with a '*'.


        <>RDFL
         FREQUENCY SAMPLING(1) OR .1KL SAMPLING(0)?
*       1
         FREQUENCY INCREMENT IN MHZ
*       10.
         SELECT THE TYPE OF INTERPOLATION
        INPUT 0 --> TWO-POINT INTERPOLATION ; NO SMOOTHING
        INPUT 1 --> INTERPOLATION AND SMOOTHING USING A COSINE WINDOW
*       0
         ASSUMED INPUT AMPLITUDE IS IN DB/SQUARE CM
         NORMALIZE TO: SQ CM(1),SQ M(2),PI*L*L/4(0)?
*       2
         TYPE DATA FILE NAME
*       NAME.DAT
        Dummy file for procedure definition
             a 6 in. sphere
        NL1200 FF= 1000 IN=    9     frequency domain

*       <>WND
        INPUT HARMONICS;START,END,TYPE OF WINDOW
        TYPE:0=HANNING,1=HAMMING,2=GAUSSIAN, 0,N,M,=TEST
*       100,1200,0
*       <>DCV
        INPUT THE HARMONIC NUMBER TO BE MOVED TO DC
```

```
*       650
*       <>MWR
*       <>IFF
*       <>ROT
        ROTATE BY INCREMENTS OF:
*       1024
*       <>WRI
        FILE NAME ?
*       NEWNAME.DAT
        DO YOU WANT TO CHANGE THE FILE HEADER Y=1, N=0
*       0
*       <>DONE
        Do you wish to save this procedure definition?(Y or N)
*       Y
        Filename:
*       PROC.DEF
        Do you have a data list file?(Y or N)
*       N

        Enter the list of data files, following
        each with <RETURN>. When finished type the
        word DONE.

*       DATA1.DAT
*       DATA2.DAT
*       DATA3.DAT
*       DONE
        Do you wish to save this data list?(Y or N)
*       Y
        Filename:
*       INPUT.DAT
        Is there an output filename list?(Y or N)
*       N

        Enter a list of the output file names in
        the order they are to be used. When
        finished type DONE.

*       OUT1.DAT
*       OUT2.DAT
*       OUT3.DAT
*       DONE
        Do you wish to save this list?(Y or N)
*       Y
        Filename:
*       OUTPUT.DAT
        Your data is being processed.

                ! At this point the computer processes the data
                !   according to what you have told it to do.
                !   CHECK THE OUTPUT TO MAKE SURE IT IS WHAT YOU
                !   WANTED!!
```

2.3 CREATING AN IMAGE

The main objective of this program is to produce an image of the target on a computer monitor. The idea is that we can get this image to the point where we can identify the target with the image. This is the sequence of events used to form an image on the screen:

- read in and store all the data files needed for the image in the buffers
- CMI command
- IMG command
- $RUN USER2:[DURAL.IMAGE]CLRPL

2.3.1 Reading In the Data

Assuming that the data has been processed using some method based on methods presented earlier in this manual filtered and stored in the time domain, we can use a REA (or FTREA command if data are not processed by CIMAG2) to read in each data file and then we can use the SBF command to store all the data files in separate buffers. The SHO_BUF command can be used to give a listing of all the buffers and their contents. However the user will have to remember the polarization, buffer#, look angle, and center element for each data file so he will probably want to keep track of these things on a sheet of paper while going through this process.

2.3.2 The CMI Command

The CMI command sets up the data structures for the rest of the imaging processes. First the program will ask the user for the number of files in a given polarization. It will look like this:

NUMBER OF VV TIME DOMAIN WAVEFORMS TO BE USED?

VV stands for vertical polarization. The user should answer with an integer. Then it will ask the user these questions for each of the files for that given polarization:

BUFFER NUMBER FOR VV FILE #

LOOK ANGLE IN DEGREES FOR FILE #

CENTER ELEMENT NUMBER FOR FILE #

The center element of the file will be zero unless the user has used the rotate command on the data. After all the information for a given polarization has been accumulated, then CIMAG2 will repeat the sequence for HH (horizontal) and HV (cross polarization).

2.3.3 The IMG Command

The IMG combines all the data down into a hundred by hundred matrix. These are the questions that will be asked:

SIZE OF THE IMAGE,(1 TO 4096)=?

Generally a good value for this is around 300. The user shouldn't really use any bigger value than this since the current resolution is only hundred by hundred. When a higher resolution device is connected up to this software, it might be better to get a larger window.

LOOK ANGLE OF THE IMAGE,DEGREES?

The computer is able to spin the image that is on the screen so that it may be easier to see certain things but this doesn't really have any real affect on the image.

POLARIZATION OF THE IMAGE,(1=VV,2=HH,3=HV,4=ALL)

This is self explanatory.

After this command has finished executing then the final array is ready to be imaged. After the image is generated the computer asks,

DO YOU WANT TO STORE THE IMAGE? Y=1,N=0

If the answer is "1" then the computer asks for the name of the data file to store the image and the frequency increment for the frequency domain signal (usually 10 MHz) which is used for calculating the time axes in the plot.

2.3.4 OUTPUT THE IMAGE

In order to output the image the user should enter

$RUN USER2:[DURAL.IMAGE]CLRPL

2.4 THE LOG & FILE COMMANDS

2.4.1 Creating the History of An Image

The sequence of events necessary to create a given image can be long and complex. Many times it is advantageous to keep track of exactly what has been done to a file or an image. This can be especially helpful if an error occurs or you want to reevaluate a couple of different procedures. The history of the procedure can also be used to regenerate results. This is especially useful in the case of images. The image can be reproduced much faster using automated techniques rather than manually entering all the commands that are necessary. The final reason for generation of a history is that it is easy to do and if the user can take advantage of a history with little effort then why not do it?

To make the history is a simple matter. The user simply types the command LOG before he types in the procedure. CIMAG2 will prompt for a filename in which to dump the history. Then the user uses the program the same way he would if there were no history being kept. When he is finished with the procedure he types the command STO_LOG.

This closes the history file given by the LOG command.

2.4.2 Regenerating Results (the FILE command)

As was mentioned in section 5.1 the history of a procedure can be be used to regenerate the results of that procedure. To do this the user will use the FILE command. The user then types in the name of the history and the computer will take over and perform the procedure stored in the history file. When the computer is finished executing this file it will give the user this message:

CONTROL HAS RETURNED TO THE TERMINAL

At this point the user is free again to do as he wishes.

If the user would like to see the normal prompts that the computer outputs to the screen for each command so that he can follow the execution of the history file he can use the ECHO command before he uses the FILE command and the computer will output this information.

2.5 QUICK REFERENCE FOR SOME COMMANDS OF GENERAL USE

CLR - clears the main buffer

CLR_BUF - clears all the buffers

CMI - initialize buffers for imaging

COM - combine command adds time domain waveforms together

DCV - downconversion

DEF - sets the default directory for input files

DEL - deletes a file from the directory

ECHO - sets the echo for the FILE command

FFREA - FTRAN Read Command (Frequency)

FFT - fast fourier transform

FGT - trapezoidal gate

FILE - executes a history file

FTREA - FTRAN Read Command (Time)

FTY - File type for the input format

IFF - inverse fourier transform

IMG - sets up the overall parameters for image

LOG - creates a log or history file

MJW - multiply by jw

NO_ECHO - stops the echo for the FILE command

PLO - plot command plots a data file on one of the plotting devices

PROC - procedure definition

RBF - read buffer

RDFL - read frequency domain file

REA - read time domain file

RLB - relabel the file header

ROT - rotate a time domain file

SBF - store in buffer

SHO_BUF - sho the contents of all the buffers

STO_LOG - stop the log or history

TYP - type the value of all the elements of a data file

WND - window

WRI - write time domain data file

III. CIMAG2 PROGRAMMER'S MANUAL

CIMAG2 is a very large, non-trivial program. It also has some distinct methods of control. It is the aim of this manual to familiarize the user with the methods and data structures used in CIMAG2. If more information is needed the Vax Fortran Manual will have more detailed information on file handling. The purpose of this manual is to inform the reader of names and structures unique to this program. It is suggested that the programmer read the CIMAG2 User's Manual first. This will familiarize the programmer with the commands that have been implemented and give him background for the discussions that follow.

3.1 Linking CIMAG2

CIMAG2 is a very complicated program. It is divided up into many smaller programs and data files. The data files not only include data files created by users but also data files for such structures as error messages, help libraries etc. For some of these files it is necessary to link them with the program but others must be linked. As a result the linking for CIMAG2 has become rather cumbersome. To get around this the linking for the program has been placed in the command file USER2:[DURAL.CIMAG2]CIMAG2.COM. This means that there are only two commands necessary to convert a new version of CIMAG2.FOR into an execution file:

```
$FOR/LIST CIMAG2
$@CIMAG2
```

The first command compiles the main program and creates a listing file. The second command executes the linking command file. A listing of CIMAG2.COM is given in Section (3-4). It is recommended that programmers first make changes to the NEWMAG.FOR file first. Then after the new routine has been debugged and tested NEWMAG.FOR can be copied over into CIMAG2.FOR. This means that a working version of the program will always be in CIMAG2. NEWMAG can be linked the same way that CIMAG2 is through the use of user2:[DURAL.CIMAG2]NEWMAG.COM. This command file links NEWMAG in the same a way shown below.

```
$FOR/LIST NEWMAG
$@NEWMAG
```

A listing of NEWMAG.COM can also be found in Section (3-4).

3.2 Process Control Structure

The Vax treats files and devices the same way. In other words the input from the terminal looks like a file to the Vax. This fact been used in a few of the most powerful commands in CIMAG2; namely the FILE, PROC, LOG, and STO_LOG commands. We can transfer control from the terminal to an input file and back again. This gives the user the ability to use processes that

have already been defined and define new processes himself. Here are the basics of how this process control is implemented in CIMAG2.

All devices and files that are to be used are assigned what is called Logical Unit Numbers (LU#). Each file or device will be referenced by this number in read and write statements. (When a programmer writes new software for CIMAG2 he should not use any ACCEPT or TYPE statements in his code. These two statements will defeat the purpose of this whole method of control.) Here are the three basic control structures:

```
COM_UNIT ,          ! LU# for the command input
IOUT ,              ! LU# for the program output
LOG_UNIT ,          ! LU# for the log file
```

COM_UNIT and IOUT can be set to either the terminal or a file. The LOG_UNIT can either be set to a file or to the null device. Using these three structures the I/O for a given routine would be written like this:

```
READ (COM_UNIT,*)  X
WRITE (LOG_UNIT,*)  X
        .
        .
        .
WRITE (IOUT,*)  X
```

Notice how the input was immediately written to the LOG_UNIT. All input should be done this way. This allows the routine to be used in procedure definitions and logging files. The format "*" was used in this example but any numbered format

may be used just as in any Fortran programming. For these structures to be used in this way they must be assigned values that correspond to the various devices and files. Here are some variable names that are assigned:

```
TERM_UNIT ,          ! LU# for the terminal
FILE_UNIT ,          ! LU# for the command file
NULL_UNIT,           ! LU# of null device
STO_UNIT             ! LU# for buffer storage
```

Using these variables this is the way that the structures are initialized:

```
COM_UNIT = TERM_UNIT
IOUT = TERM_UNIT
LOG_UNIT = NULL_UNIT
```

Initially the input is coming from the terminal, the output is going to the terminal, and we are logging to the null unit which means we really aren't logging anywhere.

3.3 Installing a New Routine

In order for a routine to be used by this program it must be written in a particular format. This format is outlined in section 3.2. PROCESS CONTROL.

Once the routine is properly formatted it will probably need to change values of some of the variables included in common blocks. The following is a list of the files in which the common blocks used by this program are stored:

MAGCMN.FOR	Contains all the working variables and arrays of the program.

MAGCMN2.FOR	The program control variables.
HEADER.CMN	All the variables that define the data header fields.
FTRN.FOR	Common variables used in FTRAN read routine.

You may also want to include something in the helps. All the helps are in a file called:

CIMAG2.HLP

To convert this into a library file, enter:

```
LIBRARY/CREATE/HELP CIMAG2.HLB CIMAG2.HLP
```

CIMAG2.HLB

(Content of the existing HELP file is listed in Appendix A).

There is another utility this program uses called the message utility. If you wish to use this utility to generate error messages, the existing message file is:

CIMAGMSG.MSG

When the utility is ran the output will be put into a file named:

CIMAGMSG.OBJ

More details on this utility are included in the Vax manuals.

3.4 Listing of the Linking Command Files

```
$ !
$ !    This command procedure links the modules for the CIMAG2 program.
$ !
$ LINK\NOTRACE                  -
        CIMAG2                 _!Main program
       INTER,                  -!Frequency Domain Read
       RDFLE,                  -!Frequency Domain Read (called by INTER)
       FORT,                   -!Fourier Transform
       DDMPB,                  -!BSC Read
       CIMAGMSG,               -!Program Error Messages
       'GRP11LIB',             -!Plotting
       'PLOTOLD2'              _!Plotting
$ !
$ EXIT

$ !
$ !    This command procedure links the modules for the NEWMAG program.
$ !
$ LINK\NOTRACE                  -
        NEWMAG,                 -
       INTER,                  -!Frequency Domain Read
       RDFLE,                  -!Frequency Domain Read (called by INTER)
       FORT,                   -!Fourier Transform
       DDMPB,                  -!BSC Read
       CIMAGMSG,               -!Program Error Messages
       'GRP11LIB',             -!Plotting
       'PLOTOLD2'              _!Potting
$ !
$ EXIT
```

REFERENCES

[1] Dominek, A., Personal Communication, The Ohio State University ElectroScience Laboratory, Columbus, Ohio.

[2] Dural, G. and J.D. Young, "Polarimetric ISAR Imaging Using Either Measured or Calculated Transient Signatures," Technical Report 718048-6, The Ohio State University ElectroScience Laboratory, Department of Electrical Engineering, generated under Contract No. N00014-86-K-0202, for Department of the Navy, Office of Naval Research, Arlington, Virginia, October 1987.

APPENDIX A

CIMAG2 HELP LIBRARY

1 DCL_Commands

The user may use DCL commands while he is still in the program by simply typing '$' before the command he wants to use. In this way he may use the $DIR command to see the files that are available in a given directory, run a calibration program and then use this new data with the data that he already had in the program, etc...

Warning:

The user will not be able to use the $SET DEFAULT command due to the way in which the DCL commands are enabled. The default will be set to whatever the default was when the user entered the program. This means he will to fully specify directory names if he wishes to use other directories. When in the program however he may use the DEF command to set the default for the program's read statements.

2 $SPAWN

If the user uses the $SPAWN command he can in effect suspend the program and open up a new terminal. From here he can do anything he wants. When he is through he simply logs out and then he will find himself back in the program in the same spot he left.

1 BSC

This routine reads data from a basic scattering code calculation.

1 CHANGE

This command allows the user to change the value of any harmonic in a file. This was originally intended for use in creating test files but the user may find other uses for it.

2 Parameters

The computer will ask:

Which harmonic do you wish to change?

(Answer with an integer between 1 and 4096 representing the number of the harmonic you wish to change.)

Then it will give you some information and then ask you for a new value:

Current Value: [The harmonic number] [The current value]
New Value:
(Answer with a DECIMAL NUMBER. This is most important. If the user forgets to put in the decimal point then the program will give erroneous results.)

It is a good idea to use the TYP command to check the file to make sure that the results turn out to be what they were intended to be.

1 CREATE

Creates a blank time domain file in the main buffer. The values of all the harmonics will be zero.

2 PARAMETERS

The program will ask the user for a three line header. The user simply types in each line of the header finishing each with a carriage return. When all three lines have been typed in the program will give the user the command prompt.

1 CLR

Clears the main buffer by setting all values to zero.

1 CLR_BUF

Clears all buffers including the main buffer.

1 CMI

Routine to set up the parameters for a two dimensional image.

1 COM

The combine command calculates any linear combination of the data in any number of the storage buffers and puts the result into the main buffer.

IMPORTANT NOTE: TIME domain waveforms are LINEAR, so combine is ADDITION or SUBTRACTION. FREQUENCY spectra are LOGARITHMIC, so combine is MULTIPLICATION or DIVISION of spectra. (Same as convolution or deconvolution in the time domain.)

2 Parameters

It starts by clearing the main buffer. Then it asks:

STORAGE BUFFER NUMBER(USE 0 TO FINISH):

(reply with a buffer number n or 0 to finish the combination process and CARRIAGE RETURN)

MULTIPLIER =

(reply with a floating point number a and CARRIAGE RETURN).

Then the main buffer will be:

BUF(0)=a1*BUF(n1)+a2*BUF(n2)+a3*BUF(n3)+........

1 DATA

This command puts the user in the Database program. This is a separate program designed to find data files using the header. It has it's own HELP command once the user gets into the program. When the user wishes to return to the CIMAG2 program he simply types EXIT and he will find himself wherever he left off before he entered the Database.

1 DCV

Routine to downconvert a spectrum to a dual-polarity envelope. The user chooses the harmonic number to call his "center frequency" which gets converted to the DC term.

The routine works on a frequency spectrum in the main buffer and returns the result to the main buffer.

1 DEF

Sets the default directory to a new default for the program's input read statements. This gives the user the ability to input data files from anywhere in the computer without having to fully specify devices and directories every time.

2 Parameters

It will ask:

DEFAULT?

The user should answer the same way that he would for the DCL command:

Device:[directory]

eg:

USER1:[STEVIE.747]

1 DEL

Deletes a data file in VAX memory device.

2 Parameters

ENTER THE FILE NAME

(reply with up to 50 characters, CARRIAGE RETURN)

1 DIF

The differentiate command calculates the derivative of the TIME DOMAIN waveform in main buffer and places the result in main buffer.

1 DJW

Divides the frequency spectrum in main buffer by j*2*pi*f (equivalent to integration in the time domain) and places the result back in main buffer.

1 ECHO

For use with a command file. If the user wishes to have the commands displayed as the command file executes them he may do so by using this command. To turn the echo off again he simply uses the NO ECHO command.

1 EXI

Exit Command

1 FFT

This command performs the "fast Fourier Transform" on a 4096 point time domain waveform that resides in the main buffer (buffer 0). It then places the resulting 2048-harmonic spectrum back in the main buffer.

1 FGT

This frequency spectrum gating routine performs a trapezoidal gate on the log amplitude components ($0 \leq n \leq 2048$) while leaving the phase spectral components ($2049 \leq n \leq 4096$) unchanged. It modifies the spectrum in main buffer.

2 Parameters

HARMONIC FOR START OF HIGH FREQUENCY CUTOFF
(reply with integer "a", CARRIAGE RETURN)
HIGH FREQUENCY ROLL-OFF IN DB PER HARMONIC
(reply with a floating point value, CARRIAGE RETURN)
HARMONIC FOR START OF LOW FREQUENCY CUTOFF
(reply with integer "b", CARRIAGE RETURN)
LOW FREQ ROLLOFF IN DB PER HARMONIC
(reply with a floating point value, CARRIAGE RETURN)

The amplitude spectrum in main buffer is unchanged between harmonics a and b. It is attenuated at the rates specified for harmonics above and below those values.

1 FILE

This command gives control of the program to a specified command file. When the new file takes control it puts the old command device on a stack. When the command file is finished it may then return control to the old device or it may give control to another command file by using the FILE command itself. However it must eventually pass control back to the device that gave it control. When the user can again enter commands he will be given the prompt:

CONTROL HAS RETURNED TO THE TERMINAL

2 Command_files

The command files are just what the name implies: a list of commands. The file however must also include everything the user would normally type in. So all of the prompts must be answered such as:

BUFFER#?

The easiest way to do this is through the use of the LOG command.

2 Parameters

FILE?: This is asking for the name of the new command file.

1 FFREA

Reads a data file written by [DOMI.DAT]FTRN. (FTRN REA Command)-Frequency Domain.

1 FRD

Reads a frequency domain data file set in the old standard bands of 1-2,2-4,4-8,8-12 GHz into the main buffer in place of its present contents. See Bill Leeper for further info.

1 FTREA

Reads a data file written by [DOMI.DAT]FTRN. (FTRN REA Command)-Time Domain

1 FTY

File type control for the data processed by FTRAN.
T=750 F=11/23
(Program initially sets to 11/23)

1 GAT

This command performs a trapezoidal gate of the data in the main buffer.

2 Parameters

START GATE OPEN(SAMPLE NO.)

(reply with integer "a", $1 \leq a \leq 4096$)

START GATE CLOSE AT SAMPLE

(reply with integer "b", $b>a, 1 \leq b \leq 4096$)

RAMP LENGTH IN SAMPLES =

(reply with integer "c")

Then if the main buffer is X(n), and the result to be placed in the main buffer is X'(n):

$X'(n)=0$ for $n<a$
$X'(n)=X(n)*(n-a)/c$ for $a<n \leq (a+c)$
$X'(n)=X(n)$ for $(a+c) \leq n \leq b$
$X'(n)=X(n)*(n-b)/c$ for $b<n \leq (b+c)$
$X'(n)=0$ for $(b+c) \leq n \leq 4096$

1 GRID

Creates a time domain file that has a pulse at every given number of nanoseconds. When this file is imaged it effectively gives the user a time scale.

WARNING: Due to the resolution of the system a pulse will usually have to be several harmonics wide, depending on the widow, in order for it to be picked up. It is a good idea to use the TYP command to see how many pulses you should see in a given window to make sure that they were all picked up in the scan.

2 Parameters

How many nanoseconds per division?

(Answer with a DECIMAL number. Make sure the decimal is included.)

Type in header:(Three lines)

(Type in the three header lines ending each with a CARRIAGE RETURN.)

How many harmonics wide should the line be?

(Answer with an integer. Remember this system is set up for continuous wave forms and not pulses so the pulse may have to be several harmonics wide; i.e., I have found 7 harmonics to work best for a window size of 300. As the window gets smaller fewer harmonics will be needed.)

1 IFF

This command performs the inverse of the "fast Fourier Transform" on a 2048-harmonic spectrum in the main buffer and places the resulting 4096-point time domain waveform back in the main buffer.

1 IMG

Routine to form the image for one polarization from time domain waveforms as set up by the CMI command.

1 INT

The integrate command calculates the integral of the TIME DOMAIN waveform in main buffer and places the result in main buffer.

1 LOG

Logs the user input into a command file. This is a good way to build command files for the FILE command. You can stop logging with the STO_LOG command.

2 Parameters

LOG FILE?: Give a name for the file to which the log is to be sent.

2 Command_files

The log command is the easiest way to make command files for the FILE command. It automatically takes all the input from the input device and makes a file out of it.

If the user wishes to put comments in the log file he may do so by using '!' as the first character of a command. The program will ignore it but it will be logged into the log file. This is a very good way of identifying what a given command file does or even what a section of one does.

The only other thing to remember when making command files is that it is a good idea to set the default in the very first line through the use of the DEF command. In this way a given command file can be run regardless of what the default was set at previously.

1 MANUALS

There are two manuals for the CIMAG2 program:

- CIMAG2 USER'S MANUAL   USER.TXT
- CIMAG2 PROGRAMMER'S MANUAL   PROG.TXT

The user's manual gives information on the procedures used to create images and manipulate data. The programmer's manual gives information that might be helpful to someone wanting to make changes or additions to the program. To get a copy of either text the user simply needs to use either the NEC command to get a copy from the spinwriter or the PRINT command to get a copy from the printer. This can be done from inside the program or from the monitor. (See DCL_Commands)

e.g.
```
$LASER USER.TXT
```

1 MJW

Multiplies the frequency spectrum in main buffer by j*2*pi*f (equivalent to differentiation in the time domain) and places the result back in main buffer.

1 MWR

Multiplies the frequency domain spectrum in main buffer by 2*pi*f and places the result back in the main buffer.

1 NO_ECHO

Turns off the echo that was enabled by the ECHO command.

1 NOR

This normalize command calculates the mean of the 4096 point waveform in the main buffer and shifts the main buffer waveform so its mean is zero.

1 PIM

This routine plots an isometric view of a single polarization two-dimensional target image on the plot device in isometric form with no shadowing.

1 PLO

The PLOT command allows the user to plot any one of the buffers on one of the plotting devices listed.

2 Parameters

WAVEFORM BUFFER NUMBER?

(reply with the number of the buffer in which the desired waveform is stored)

DO YOU WANT A NEW WINDOW? (1=Y,0=N)

(this allows you to choose what section of the wave you want to look at or you may look at the whole thing. If your answer is 1 then it will ask the for the range of data numbers you want to look at ($1 \leq a \leq 4096$). If your answer is 0 then it will default to the window that you used last.)

DO YOU WANT NEW AXES?

(this allows you to fix the labeling for the graph)

INPUT TITLE FOR PLOT?

(this is the title for the top of the plot. Type in any title desired.)

Then it gives you a list of devices on which you may output the plot. Just type the number of the device which you wish to use.

1 PROC

This operation allows the user to specify a process to be performed on a group of files. Then it will ask for the list of data files and a list of the output filenames desired. It will then run each of the data files through the defined process and make output files as requested.

2 Procedure

The user is given explicit instructions throughout the procedure. There are only a few points that need to be stressed here:

- The filename NAME.DAT will be used for all input data files. This has to be typed in capital letters.

- The filename NEWNAME.DAT is used for all output file names. It also has to be typed in capital letters.

- When making either of the filename lists if a given file is used more than once it has to be listed more than once.

- Filenames are used in the order that they appear in the lists.

- Whenever the user finishes defining a process or a list he/she will type the word "DONE" in capital letters and the procedure will move on to the next phase.

WARNING: This is a very powerful command but the user must be very careful when using it so that the output files will have the desired content and not some other content without the users knowledge.

1 PSM

Point smooth command fits a cubic curve to points surrounding a small bad region of time waveform or spectrum for the data in main buffer.

2 Parameters

For TIME waveforms it asks:

FIRST BAD POINT INTEGER=

(reply with the integer for the first point to be replaced, CARRIAGE RETURN)

LAST BAD POINT INTEGER=

(reply with the integer for the last point to be replaced.This can be the same as the first point)

For FREQUENCY spectrum in main buffer,it asks:

FIRST BAD HARMONIC

(reply with a harmonic # between 0 and 2048, CARRIAGE RETURN)

LAST BAD HARMONIC

(reply with a second harmonic #, perhaps same as first)

For both cases,the bad section of data is replaced in main buffer with values which join surrounding values with continuous slope.

1 RBF

This command reads the contents of a storage buffer into the main buffer.

2 Parameters

BUFFER#: There are 35 buffers. This number is used to specify which one is to be used.

1 RDFL

Reads a modern frequency domain file into the main buffer in place of its present contents. It asks:

INPUT

1 REA

Reads a time domain file in "Jon Young format" from a VAX storage device into the main buffer (destroys what was in main buffer before).

2 Parameters

INPUT FILE ?

(reply with up to 50 characters for a VAX file name)

WAVEFORM NUMBER?

(reply with an integer,since "Jon Young format" files will accept more than one waveform per file; normally 1 is used with those files which have only one waveform in them)

If the name is unrecognized or if any other error happens, the routine aborts and the "ERROR IN COMMAND" message is printed.

1 RLB

The re-label command. It will print out the first line of the old title block and then wait for the user to type in the new line.

OLD TITLE BLOCK:

Whatever the line is

NEW TITLE BLOCK:

The user then simply types in whatever the new line is to be.

1 ROT

Rotates the data in main buffer by "a" increments to the right(+a) or left(-a),with values shifted beyond 0 or 4096 appearing on the other end of the waveform. It asks:

ROTATE BY INCREMENTS OF:

(reply with "a", CARRIAGE RETURN)

1 SBF

This command stores the contents of the main buffer into one of the storage buffers.

2 Parameters

BUFFER#: There are 35 buffers. This number is used to specify which one is to be used.

1 SCT

This smooth cutoff tail routine attaches a shifted cosine amplitude spectrum attenuation function to the spectrum in main buffer to eliminate Gibbs phenomenon in the time waveform.

2 Parameters

INPUT THE STARTING AND END POINT FOR THE FREQ ROLLOFF
(reply with a pair of integers,
"a", "b", $0 \leq a, b, \leq 4096$)

The spectrum is unchanged for $n \leq a$. It is -100 db for $n \geq b$. And for $a \leq n \leq b$, the spectrum has a cosine rolloff.

1 SHO_BUF

This command shows the contents of all of the buffers that have anything in them. The buffer number is given for each entry. The domain of the file is also given (time or freq). This is the format:

BF#   DOMAIN
DESCRIPTION ...

1 STO_LOG

The stop logging command stops the input from going to the logging file. It assumes that the user was writing to a logging device.

1 TYP

Type a portion of data in a buffer. This data is typed out in numerical form so that the user can see the actual data values of individual points.

2 Parameters

START AT ELEMENT NUMBER:
(reply with an integer from 1 to 4096, CARRIAGE RETURN)

END AT ELEMENT NUMBER:
(reply with a second integer, 1 to 4096, CARRIAGE RETURN)

BUFFER NUMBER(0=MAIN):
(reply with a buffer integer #,0 to 8, CARRIAGE RETURN)

The specified portion of the specified buffer is then typed out on the CRT screen.

1 WND

This routine attaches a smooth cutoff tail to the spectrum in order to reduce Gibb's Phenomenon.

2 Parameters

INPUT HARMONICS;START,END,TYPE OF WINDOW

TYPE:0=HANNING,1=HAMMING,2=GAUSSIAN, 0,N,M=TEST
(reply with a pair of integers,
"a", "b",0≤a,b,≤4096 and then 0, 1, or 2
depending on the type of rolloff desired)

1 WRI

Writes a time domain waveform in the main buffer to a specified VAX memory device in "Jon Young format". The data in main buffer is not changed.

2 Parameters

FILE NAME ?
(reply with a name up to 50 characters,
CARRIAGE RETURN)

1 YSH

Shifts the data in buffer up(+) or down(-) by Y units.

2 Parameters

YSHIFT IN UNITS(-2048<Y<2048)=
(reply with the shift value, CARRIAGE RETURN)

APPENDIX B

THE COLOR IMAGING PROGRAM 'CIMAG2'

```
C       CIMAG2
C
C
        CHARACTER*80 COMMAND                                        ! the command
C
        INCLUDE 'USER2:[DURAL.CIMAG2]FTRN.FOR'
        INCLUDE 'USER2:[DURAL.CIMAG2]MAGCMN.FOR'
        INCLUDE 'USER2:[DURAL.CIMAG2]MAGCMN2.FOR'                  ! common blocks
        INCLUDE 'USER2:[DURAL.CIMAG2]HEADER.CMN'
C
        EQUIVALENCE (HEADER,HEAD(1,1)),(LINE1(1),HEADER(1))
        EQUIVALENCE (FLTP,IDS(1)),(HEADER(61),LINE3(1)),(HEADER(31),LINE2(1))
C
        INTEGER*4 FOR_RETCODE                            ! fortran return code
        INTEGER*4 FOR_EOF / -1 /                         ! end of file code
        INTEGER*4 RETCODE                        ! return code for RTL routines
        INTEGER*4 LIB$GET_LUN                    ! 'get LU#' RTL routine
C
C
        CALL START                               ! initialize all the variables
C
        RETCODE = LIB$GET_LUN( TERM_UNIT )
        OPEN( FILE='TT:' ,                               ! open terminal for I O
     +          UNIT=TERM_UNIT ,
     +          STATUS='NEW' )
C
C
        RETCODE = LIB$GET_LUN( NULL_UNIT )               ! null unit for logging
        OPEN( FILE='NL:' ,
     +        UNIT=NULL_UNIT ,
     +        STATUS='NEW' )
C
C
        COM_UNIT=TERM_UNIT                 ! get commands from terminal initially
        IOUT=TERM_UNIT                     ! send output to the terminal
        LOG_UNIT=NULL_UNIT                               ! log to null unit
C
C
C
        DO WHILE (COMMAND .NE. 'EXI')                    ! do until exit command
                IF (COM_UNIT .EQ. TERM_UNIT) THEN      ! if waitng for a command
C from terminal
                        IOUT=TERM_UNIT          ! then all prompts go to terminal
                        WRITE( UNIT=IOUT, FMT=5 )
                ELSE                                   ! if using a command file
                        IF (ECHO) THEN                 ! output can either be
                                IOUT=TERM_UNIT         !displayed on terminal
                        ELSE                     !or not be displayed at all
                                IOUT=NULL_UNIT
                        END IF
                END IF
                READ ( UNIT=COM_UNIT , FMT=10 ,                  ! read the command
     +                  IOSTAT=FOR_RETCODE ) COMMAND
C
                IF (FOR_RETCODE .EQ. FOR_EOF) THEN    ! on end of file get old
C control device
                        CALL BACK
                        IF(PROC_FLAG) THEN     ! if coming back from a procedure
                                CALL PROC3     ! finish off the PROC procedure
                        END IF
```

```
                ELSE
C
                CALL STR$UPCASE( COMMAND , COMMAND )! convert to uppercase
C
C
                        IF ((COMMAND .NE. 'STO_LOG') .AND.      ! if command is
C  not equl to
     +                          (COMMAND .NE. 'FILE') .AND.      !  stop log or
C  run command file
     +                          (COMMAND .NE. 'DONE')) THEN
                                        WRITE( UNIT=LOG_UNIT , FMT=10 ) ! log
C  the input
     +                                          COMMAND
                        END IF
C
                        IF (COMMAND .EQ. 'BSC') THEN    ! execute the command
                        CALL BSC
C                       ELSE IF (COMMAND .EQ. 'CARD') THEN
C                               CALL CARDC
                        ELSE IF (COMMAND .EQ. 'CHANGE') THEN
                                CALL CHANGE
                        ELSE IF (COMMAND .EQ. 'CLR') THEN
                                CALL CLR
                        ELSE IF (COMMAND .EQ. 'CLR_BUF') THEN
                                CALL CLR_BUF(HEAD, LINE1, LINE2, LINE3)
                        ELSE IF (COMMAND .EQ. 'CMI') THEN
                                CALL CMI
                        ELSE IF (COMMAND .EQ. 'COM') THEN
                                CALL COM(HEAD, LINE1, LINE2, LINE3)
                        ELSE IF (COMMAND .EQ. 'CREATE') THEN
                                CALL CREATE(HEAD, LINE1, LINE2, LINE3)
                        ELSE IF (COMMAND .EQ. 'DATA') THEN
                                CALL LIB$SPAWN( 'RUN USER2:'
     +                          //'[DURAL]DBMANAGER') ! use the database
                        ELSE IF (COMMAND .EQ. 'DCV') THEN
                                CALL DCV
                        ELSE IF (COMMAND .EQ. 'DEF') THEN
                                CALL DEFFER             ! set def command
                        ELSE IF (COMMAND .EQ. 'DEL') THEN
                                CALL DEL
                        ELSE IF (COMMAND .EQ. 'DIF') THEN
                                CALL DIF
                        ELSE IF (COMMAND .EQ. 'DJW') THEN
                                CALL DJW
                        ELSE IF (COMMAND .EQ. 'DONE') THEN
                                CALL PROC2
                        ELSE IF (COMMAND .EQ. 'DWR') THEN
                                CALL DWR
                        ELSE IF (COMMAND .EQ. 'ECHO') THEN      ! shows command
C file instructions as they are
                                ECHO=.TRUE.             ! being executed.
                        ELSE IF (COMMAND .EQ. 'FFT') THEN
                                CALL FFT
                        ELSE IF (COMMAND .EQ. 'FGT') THEN
                                CALL FGT
                        ELSE IF (COMMAND .EQ. 'FILE') THEN
                                CALL FILE
                        ELSE IF (COMMAND .EQ. 'FRD') THEN
                                CALL FRDC
                        ELSE IF (COMMAND.EQ.'FTREA') THEN
                                CALL FTREA
                        ELSE IF (COMMAND.EQ.'FFREA') THEN
                                CALL FFREA
                        ELSE IF (COMMAND.EQ.'FTY') THEN
                                CALL FTY
                        ELSE IF (COMMAND .EQ. 'GAT') THEN
```

```
                    CALL GAT
            ELSE IF (COMMAND .EQ. 'GRID') THEN
                    CALL GRID(HEAD, LINE1, LINE2, LINE3)
            ELSE IF (COMMAND .EQ. 'HELP') THEN
                    CALL LIB$SPAWN('HELP/PAGE/LIBRARY=USER2:'
     +                      //'[DURAL.CIMAG2]CIMAG2.HLB')     ! call
C  help files
            ELSE IF (COMMAND .EQ. 'IFF') THEN
                    CALL IFF
            ELSE IF (COMMAND .EQ. 'IMG') THEN
                    CALL IMG
            ELSE IF (COMMAND .EQ. 'INT') THEN
                    CALL INTEG
            ELSE IF (COMMAND .EQ. 'LOG') THEN
                    CALL LOGGER
            ELSE IF (COMMAND .EQ. 'MJW') THEN
                    CALL MJW
            ELSE IF (COMMAND .EQ. 'MWR') THEN
                    CALL MWR
            ELSE IF (COMMAND .EQ. 'NO_ECHO') THEN
                    ECHO=.FALSE.
            ELSE IF (COMMAND .EQ. 'NOR') THEN
                    CALL NOR
            ELSE IF (COMMAND .EQ. 'PIM') THEN
                    CALL PIM
            ELSE IF (COMMAND .EQ. 'PLO') THEN
                    CALL PLO
            ELSE IF (COMMAND .EQ. 'PROC') THEN ! process data
                    CALL PROC
            ELSE IF (COMMAND .EQ. 'PSM') THEN
                    CALL PSM
           ELSE IF (COMMAND .EQ. 'RDFL') THEN
                    CALL RDFL(HEAD, LINE1, LINE2, LINE3)
            ELSE IF (COMMAND .EQ. 'REA') THEN
                    CALL REA(HEAD, LINE1, LINE2, LINE3)
            ELSE IF (COMMAND .EQ. 'RBF') THEN
                    CALL RBF(HEAD, LINE1, LINE2, LINE3)
            ELSE IF (COMMAND(1:2) .EQ. 'RB') THEN
                    NB = ICHAR( COMMAND(3:3) ) - 48
                    CALL RB(HEAD, LINE1, LINE2, LINE3)
            ELSE IF (COMMAND .EQ. 'RLB') THEN
                    CALL RLB
            ELSE IF (COMMAND .EQ. 'ROT') THEN
                    CALL ROT
            ELSE IF (COMMAND .EQ. 'SBF') THEN
                    CALL SBF(HEAD, LINE1, LINE2, LINE3)
            ELSE IF (COMMAND(1:2) .EQ. 'SB') THEN
                    NB = ICHAR( COMMAND(3:3) ) - 48
                    CALL SB(HEAD, LINE1, LINE2, LINE3)
            ELSE IF (COMMAND .EQ. 'SHO_BUF') THEN
                    CALL SHO_BUF
            ELSE IF (COMMAND .EQ. 'STO_LOG') THEN
                    CALL STO_LOG
            ELSE IF (COMMAND .EQ. 'TYP') THEN
                    CALL TYP(HEAD, LINE1, LINE2, LINE3)
            ELSE IF (COMMAND .EQ. 'WND') THEN
                    CALL WND
            ELSE IF (COMMAND .EQ. 'WRI') THEN
                    CALL WRI(HEAD, LINE1, LINE2, LINE3)
            ELSE IF (COMMAND .EQ. 'YSH') THEN
                    CALL YSH
            ELSE IF (COMMAND .EQ. '    1') THEN
            CONTINUE          !       clause on the old REA command
            ELSE IF (COMMAND(1:1) .EQ. '$') THEN              ! If a
C  DCL command
                    CALL LIB$SPAWN( COMMAND ) ! execute the DCL
```

```
C  command
                                    ELSE IF (COMMAND(1:1) .EQ. '!') THEN            ! if
C command file comment
                                            IF (COM_UNIT .NE. TERM_UNIT) THEN       ! if
C commands are not coming from the terminal
                                                    WRITE(IOUT,10) COMMAND   ! output the
C comment
                                            END IF
                                    ELSE IF (COMMAND .NE. 'EXI') THEN       ! If not exit
C then it must be undefined
                                            WRITE(IOUT,*) '?'
                                    END IF
                            END IF
C
        END DO
C
C
5       FORMAT( 1X , '<>' , $ )
10      FORMAT( A )
C
        STOP                                                    ! do a fortran stop
        END
C
C
C
        SUBROUTINE COM_FILE(HEAD, LINE1, LINE2, LINE3)
C

        INCLUDE 'USER2:[DURAL.CIMAG2]FTRN.FOR'
        INCLUDE 'USER2:[DURAL.CIMAG2]MAGCMN.FOR'
        INCLUDE 'USER2:[DURAL.CIMAG2]MAGCMN2.FOR'
        INCLUDE 'USER2:[DURAL.CIMAG2]HEADER.CMN'
        INCLUDE 'USER2:[DURAL.CIMAG2]MSGBLK.FOR'                        ! the er
C
C
        INTEGER*4 SYS$ALLOC ,                                   ! allocate routine
     +            SYS$DALLOC                                            ! deallocate
C
        INTEGER*4 FOR_RETCODE                                   ! fortran return code
        INTEGER*4 RETCODE                       ! return code for system operations
        INTEGER*4 SS$_NORMAL ,                                          ! normal return
     +            SS$_DEVALLOC   ! device already allocated to another process
C
        PARAMETER (SS$_NORMAL = '00000001'X)
        PARAMETER (SS$_DEVALLOC = '00000840'X)
C
C
C       THE INITIALIZATION ROUTINE
C
C
C       EXTERNAL CTRL_C_HDLR
C       CALL LIB$ESTABLISH(CTRL_C_HDLR)                                 ! Initializ
        ENTRY START
        FTYPE=F
        ECHO=.FALSE.
        PROC_FLAG=.FALSE.
        DEFINE_FLAG=.FALSE.
        ISIZE=4096
        IS=ISIZE/2.
        FLTP=0.
        IHDSZ=256
        IDSSZ=1
        PI=3.14159
        IZ=12
        ISM2=(ISIZE/2)-2
        NBUF=30
```

```
      IMEG=0
      IWIN1=1
      WIN1=1.
      IWIN2=2048
      WIN2=2048.
      WIN3=-1024.
      WIN4=1024.
      YMAX=1
      YMIN=-1
      YTMI=1
      YLAB=' '
      XMAX=2048
      XMIN=1
      XTMI=512
      XLAB=' '
      EFLAG = .FALSE.
      DATA CARRAY/0,0,0,0,0,0,6,0,6,0,7,0,6,0,6,1,6,1,6,2,5,
     1            2,5,3,4,6,4,6,1,11,1,11/
      DATA CLRTAB/6,3,7,2,4,5/
C
C
C     NOW CONSTRUCT FFT SINE TABLE
C
      CALL FORT(A,IZ,S,0,IFERR)
      TYPE *,'Instructions on CIMAG2 available through the command HELP'
C

C
      RETURN                                  ! Initialization is finished
C
C
C
      ENTRY FFT
      DOMAIN='FREQ'
      FLTP=1.
      DO 20 N=1,ISIZE
20    A(N)=CMPLX(1.,0.)*P(N,1)
      CALL FORT(A,IZ,S,-2,IFERR)
      IF(IFERR.NE.0) THEN
              CALL LIB$SIGNAL(MAG_COM)
              RETURN
      END IF
      RT2=SQRT(2.)
      X=CABS(A(1))
      IF(X.LT.1.E-20) X=1.E-20
      P(1,1)=10.24*(10.+20.*ALOG10(X))
      IS=ISIZE/2.
      P(IS+1,1)=512.*ATAN2(AIMAG(A(1)),REAL(A(1)))/PI
      PMAX=-1.E-20
      DO 21 N=2,IS
      NN=IS+N
      X=CABS(A(N))
      IF(X.LT.1.E-20) X=1.E-20
      P(N,1)=10.24*(10.+20.*ALOG10(X*RT2))
      IF(P(N,1).GT.PMAX) PMAX=P(N,1)
      X=CABS(A(N))
      IF(X.EQ.0)P(NN,    0
21    IF(X.NE.0)P(NN,1)=512.*ATAN2(AIMAG(A(N)),REAL(A(N)))/PI
      RETURN
C
C
C     IFFT ROUTINE
      ENTRY IFF
      DOMAIN='TIME'
      FLTP=0.
      RRT2=1./SQRT(2.)
```

```
      P(1,1)=(P(1,1)/10.24)-10.
      IS=ISIZE/2.
      P(IS+1,1)=PI*P(IS+1,1)/512.
      A(1)=CMPLX(COS(P(IS+1,1)),SIN(P(IS+1,1)))*10.**(P(1,1)*0.05)
      DO 30 N=2,IS
      P(N,1)=(P(N,1)/10.24)-10.
      P(IS+N,1)=PI*P(IS+N,1)/512.
30    A(N)=CMPLX(COS(P(IS+N,1)),SIN(P(IS+N,1)))*RRT2*10.**(P(N,1)*.05)
      A(IS+1)=CMPLX(0.,0.)
      DO 31 N=2,IS
      NN=ISIZE+2-N
31    A(NN)=CMPLX(REAL(A(N)),-AIMAG(A(N)))
      CALL FORT(A,IZ,S,2,IFERR)
      IF(IFERR.NE.0) THEN                          ! Print an error message
              CALL LIB$SIGNAL(MAG_COM)
              RETURN
      END IF
      DO 32 N=1,ISIZE
      NN=ISIZE+1-N
32    P(NN,1)=REAL(A(NN))
      RETURN
C
      ENTRY FTY
      WRITE(IOUT,*)'Enter file type for FTRAN read routines'
      WRITE(IOUT,*)' T=750 F=11/23'
      READ(COM_UNIT,*)FTYPE
      WRITE(LOG_UNIT,*)FTYPE
      RETURN
C
C     FTRAN 'REA'COMMAND (FREQUENCY DOMAIN)
C
      ENTRY FTREA
      FLTP=1
      IF(.NOT.FTYPE) CALL FREA(INPFILE,AMPL,PHS)
      IF(FTYPE) CALL REU(INPFILE,AMPL,PHS)
      RETURN
C
C     FTRAN 'REA' COMMAND (TIME DOMAIN)
C
      ENTRY FFREA
      FLTP=0
      IF(.NOT.FTYPE) CALL FREA(INPFILE,AMPL,PHS)
      IF(FTYPE) CALL REU(INPFILE,AMPL,PHS)
      RETURN
C
C
C
C
C
C
C     DIFFERENTIATE ROUTINE
C     MULT BY JW IN THE FREQ DOMAIN
      ENTRY MJW
      SN=1.
      GOTO 40
C
C     INTEGRATE ROUTINE
C     DIVIDE BY JW IN THE FREQ DOMAIN
      ENTRY DJW
      SN=-1.
C
C
40    IS=ISIZE/2.
      IF (FLTP.NE.1.) THEN
              CALL LIB$SIGNAL(MAG_COM)
      END IF
```

```
          DO 41 N=2,IS
          NN=IS+N
          P(NN,1)=P(NN,1)+SN*256.
41        P(N,1)=P(N,1)+10.24*SN*20.*ALOG10(FLOAT(N-1))
          P(1,1)=-100
          P(IS+1,1)=0.
          RETURN
C
C
C
C         FILTER ROUTINE
C         MULT BY W IN THE FREQ DOMAIN
C
          ENTRY MWR
          SN=1.
          GOTO 45
C
C         FILTER ROUTINE
C         DIVIDE BY W IN THE FREQ DOMAIN
C
          ENTRY DWR
          SN=-1.
C
C
45        IS=ISIZE/2.
          IF (FLTP.NE.1.) THEN
                  CALL LIB$SIGNAL(MAG_COM)
          END IF
          DO 46 N=2,IS
46        P(N,1)=P(N,1)+10.24*SN*20.*ALOG10(FLOAT(N-1))
          P(1,1)=-100
          P(IS+1,1)=0.
          RETURN
C
C
C
C
C         GATE COMMAND
C         TRAPEZOIDAL GATE OF TIME DOMAIN WAVEFORM
          ENTRY GAT
48        FORMAT(F10.2)
49        FORMAT (I5)
          WRITE (IOUT,50)
50        FORMAT(' START GATE OPEN(SAMPLE NO.)=')
          READ (COM_UNIT,49) IOP
          WRITE(LOG_UNIT,49) IOP                          ! log the input
          WRITE(IOUT,51)
51        FORMAT(' START GATE CLOSE AT SAMPLE ')
          READ (COM_UNIT,49) ICL
          WRITE (LOG_UNIT,49) ICL                         ! [illegible]
          WRITE(IOUT,52)
52        FORMAT(' RAMP LENGTH IN SAMPLES =')
          READ (COM_UNIT,49) IRMP
          WRITE (LOG_UNIT,49) IRMP                        ! log the input
          IF(IRMP.EQ.0)IRMP=1
          DO 53 N=1,ISIZE
          F=0.
          RMP=FLOAT(IRMP)
          NUM=N-IOP
          FNUM=FLOAT(NUM)
          IF(N.GT.IOP)F=FNUM/RMP
          IF(F.GT.1.)F=1.
          NUM=N-ICL
          FNUM=FLOAT(NUM)
          IF(N.GT.ICL)F=1.-FNUM/RMP
          IF(F.LT.0.)F=0.
```

```
53      P(N,1)=P(N,1)*F
        RETURN
C
C
C
C
C       TYPE COMMAND
C       TYPES A BUFFER WAVEFORM SEGMENT
        ENTRY TYP(HEAD, LINE1, LINE2, LINE3)
        WRITE(IOUT,81)
81      FORMAT(' START AT ELEMENT NUMBER:',$)
        READ (COM_UNIT,86) NP
        WRITE (LOG_UNIT,86) NP                              ! log the input
        WRITE(IOUT,82)
82      FORMAT(' END AT ELEMENT NUMBER:',$)
        READ (COM_UNIT,86) NE
        WRITE (LOG_UNIT,86) NE                              ! log the input
        IF(NE.GE.ISIZE)NE=ISIZE-1
        WRITE(IOUT,83)
83      FORMAT(' BUFFER NUMBER(0=MAIN):',$)
        READ (COM_UNIT,86) NNB
        WRITE (LOG_UNIT,86) NNB                             ! log the input
        NNB=NNB+1
        IF(NNB.LT.1) THEN
                CALL LIB$SIGNAL(MAG_COM)                ! Print an error messag
                RETURN
        END IF
        IF(NNB.GT.NBUF) THEN
                CALL LIB$SIGNAL(MAG_COM)                ! Print an error messag
                RETURN
        END IF
        WRITE(IOUT,117) (HEAD(I,NNB),I=1,30)
        WRITE(IOUT,117) (HEAD(I,NNB),I=31,60)
        WRITE(IOUT,117) (HEAD(I,NNB),I=61,90)
        WRITE(IOUT,85)(N,P(N,NNB),P(N+1,NNB),N=NP,NE,2)
85      FORMAT(I5,2F10.2)
86      FORMAT (I5)
        RETURN
C
C
C   BUFFER STORE ROUTINES
C       STORE A WAVE OR SPECTRUM IN ONE OF 30 TEMP LOCS
        ENTRY SBF(HEAD, LINE1, LINE2, LINE3)
        WRITE (IOUT,87)
87      FORMAT(1X,' BUFFER #',$)
        READ (COM_UNIT,93) NB
        WRITE (LOG_UNIT,93) NB                              ! log the input
C
        ENTRY SB(HEAD, LINE1, LINE2, LINE3)                 ! SB# routine
        IF (NB .GT. 35) THEN
                CALL LIB$SIGNAL(MAG_COM)
                RETURN
        END IF
        DOM(NB)=DOMAIN
        DO 90 I= 1, 30
90      BUFFERS(NB,I) = LINE1(I)
91      CALL BUFSTR(IHDSZ,IDSSZ,ISIZE,NB,HEAD,P,IDS)
93      FORMAT (I5)
        RETURN
C
C
C   BUFFER READ ROUTINES
C       RETRIEVES WAVE OR SPECTRUM AND ITS HEADING AND ITS
C       DESCRIPTIVE PARAMETERS INTO THE MAIN BUFFER
        ENTRY RBF(HEAD, LINE1, LINE2, LINE3)
        WRITE (IOUT,88)
```

```
88      FORMAT(1X,' BUFFER #',$)
        READ (COM_UNIT,94) NB
        WRITE (LOG_UNIT,94) NB                                      ! log the input
C
        ENTRY RB(HEAD, LINE1, LINE2, LINE3)
        DOMAIN = DOM(NB)
92      CALL BUFRD(IHDSZ,IDSSZ,ISIZE,NB,HEAD,P,IDS)
94      FORMAT (I5)
        RETURN
C
C
C
C    COMBINE ROUTINE
C       COMBINES FILES FROM TEMP BUFFERS,EACH MULTIPLIED BY A
C       FACTOR,INTO THE MAIN BUFFER. HEADING AND DESCRIPTIVE PAR
C        OF THE LAST WAVEFORM WILL BE IN THE MAIN BUFFER
C
        ENTRY COM(HEAD, LINE1, LINE2, LINE3)
        DO 101 I=1,ISIZE
101     P(I,1)=0
102     WRITE(IOUT,103)
103     FORMAT(' STORAGE BUFFER NO.(USE 0 TO FINISH):')
        READ (COM_UNIT,111) IB
        WRITE (LOG_UNIT,111) IB                                     ! log the input
        IF(IB.LT.1.OR.IB.GT.NBUF)GO TO 110
        DOMAIN = DOM(IB)
        IB=IB+1
        WRITE(IOUT,104)
104     FORMAT(' MULTIPLIER=')
        READ (COM_UNIT,108) AMULT
        WRITE (LOG_UNIT,108) AMULT                                  ! log the input
        DO 105 J=1,IHDSZ
105     HEAD(J,1)=HEAD(J,IB)
        DO 107 J=1,ISIZE
107     P(J,1)=P(J,1)+AMULT*P(J,IB)
        IDS(1)=IDS(IB)
        GO TO 102
108     FORMAT (F10.2)
110     CONTINUE
111     FORMAT (I5)
        RETURN
C
C
C       ROUTINE TO READ FROM DISK
        ENTRY REA(HEAD, LINE1, LINE2, LINE3)
        DOMAIN='TIME'
        WRITE(IOUT,112)
112     FORMAT(' INPUT FILE ? ',$)
        READ (COM_UNIT,114) FILNM
        WRITE (LOG_UNIT,114) FILNM                          ! log the input
        IF((PROC_FLAG).AND.(FILNM .EQ.'NAME.DAT')) THEN ! if a pr
                DO I=1,ISIZE                          ! make a dummy time doma
                        P(I,1)=10
                END DO
                IDS(1)=0
                WRITE(IOUT,113)                       ! tell user what is going on
                RETURN
        END IF
113     FORMAT(' This is a dummy file for PROC definition.')
114     FORMAT(A50)
C
        OPEN(UNIT=1,ERR=115,FILE=FILNM,TYPE='OLD',READONLY,
     +    IOSTAT= FOR_RETCODE,DEFAULTFILE=DEF,FORM='UNFORMATTED')
        IPGF=0
        GOTO 116
115     IF (FOR_RETCODE .EQ. 29) THEN                       ! if file not found
```

```
                CALL LIB$SIGNAL(MAG_FILNOTFOU)          ! print error
                RETURN
        ELSE
                CALL LIB$SIGNAL(MAG_COM)                ! Print an error messag
                RETURN
        END IF
116     READ(1,IOSTAT=FOR_RETCODE,END=162) (HEAD(I,1),I=1,256)
        IF (FOR_RETCODE .EQ. 35) THEN
                CALL LIB$SIGNAL(MAG_INPFOR)
                RETURN
        END IF
        WRITE(IOUT,117) LINE1
        WRITE(IOUT,117) LINE2
        WRITE(IOUT,117) LINE3
117     FORMAT(X,30A2)
        DO 77812 J=1,ISIZE
77812   P(J,1)=0.
        READ(1,END=162) (P(J,1),J=1,ISIZE)
        IDS(1)=0
        GO TO 164
162     WRITE(TERM_UNIT,*) 'ERROR END OF FILE ENCOUNTERED AT ',I
164     CLOSE(UNIT=1)
165     FORMAT (I5)
        RETURN
C
C
C
C       TO DELETE A FILE ON DISK
C
C
        ENTRY DEL
        WRITE(IOUT,*) 'ENTER THE FILE NAME'
        READ (COM_UNIT,114) FILNM
        WRITE (LOG_UNIT,114) FILNM                      ! log the input
        OPEN(UNIT=1,ERR=166,FILE=FILNM,TYPE='OLD',
     +          DEFAULTFILE=DEF,DISP='DELETE')
        CLOSE(UNIT=1)
        GOTO 167
166     CALL LIB$SIGNAL(MAG_COM)                        ! Print an error messag
167     RETURN
C
C
C
C
C
C
C       THIS ROUTINE PLOTS A WAVEFORM FROM A BUFFER
C
C
        ENTRY PLO
        WRITE (IOUT,186)
        READ (COM_UNIT,187) ISEG1
        WRITE (LOG_UNIT,187) ISEG1                              ! log the input
        ISEG=ISEG1+1
        WRITE(IOUT,*)'DO YOU WANT A NEW WINDOW?(1=Y,0=NO)'
        READ (COM_UNIT,*) IANS
        WRITE (LOG_UNIT,*) IANS                                 ! log the input
        IF (IANS.NE.1) GO TO 18500
        WRITE(IOUT,*)'WINDOW VALUES ARE NOW:'
        WRITE (IOUT,4247) WIN1,WIN2,WIN3,WIN4
        WRITE(IOUT,*)'START ELEMENT FOR PLOT(0=NO CHANGE):'
        READ (COM_UNIT,*) IANS1
        WRITE (LOG_UNIT,*) IANS1                                ! log the input
        IF(IANS1.NE.0) IWIN1=IANS1
        WRITE(IOUT,*)'END ELEMENT FOR PLOT (0=NO CHANGE):'
        READ (COM_UNIT,*) IANS1
```

```
        WRITE (LOG_UNIT,*) IANS1                                ! log the input
        IF(IANS1.NE.0) IWIN2=IANS1
        WRITE(IOUT,*)'MAX PLOT VALUE (+1024 NORMAL,0=NO CHANGE):'
        READ (COM_UNIT,*) ANS
        WRITE (LOG_UNIT,*) ANS                                  ! log the input
        IF (ANS.NE.0) WIN4=ANS
        WRITE(IOUT,*)'MIN PLOT VALUE (-1024 NORMAL,0=NO CHANGE):'
        READ (COM_UNIT,*) ANS
        WRITE (LOG_UNIT,*) ANS                                  ! log the input
        IF(ANS.NE.0) WIN3=ANS
        WIN1=FLOAT(IWIN1)
        WIN2=FLOAT(IWIN2)
18500   WRITE(IOUT,*)'DO YOU WANT NEW AXES?(1=Y,0=N)'
        READ (COM_UNIT,*) ANS
        WRITE (LOG_UNIT,*) ANS                                  ! log the input
        IF (ANS.EQ.0) GO TO 18600
        WRITE(IOUT,*)'INPUT Y-AXIS MAX,MIN,AND TIK MARK INTERVAL'
        READ (COM_UNIT,*) YMAX,YMIN,YTMI
        WRITE (LOG_UNIT,*) YMAX,YMIN,YTMI                       ! log the input
        WRITE(IOUT,*)'Y AXIS LEGEND'
        READ (COM_UNIT,18601) YLAB
        WRITE (LOG_UNIT,18601) YLAB                             ! log the input
        WRITE(IOUT,*)'INPUT X-AXIS MAX,MIN,AND TIK MARK INTERVAL'
        READ (COM_UNIT,*) XMAX,XMIN,XTMI
        WRITE (LOG_UNIT,*) XMAX,XMIN,XTMI                       ! log the input
        WRITE(IOUT,*)'X AXIS LEGEND'
        READ (COM_UNIT,18601) XLAB
        WRITE (LOG_UNIT,18601) XLAB                             ! log the input
18600   WRITE(IOUT,*) 'INPUT TITLE FOR PLOT'
        READ (COM_UNIT,18601) TITLE
        WRITE (LOG_UNIT,18601) TITLE                            ! log the input
18601   FORMAT (A60)
4247    FORMAT(' STRT',F8.2,' END ',F8.2,' MIN Y',F8.2,'MAX Y',F8.2)
        YINC=WIN4-WIN3
        YZERO=WIN3+YINC/2.
        XINC=WIN2-WIN1
        IXINC=INT(XINC)
C       DRAW THE CURVE USING A SQUARE 7 IN PLOT
        CALL VPLOTS(0,0,0)
        PSIZE=7.
        CALL PLOT(0.5,5.5,-3)
        DO 18610 I=1,IXINC
        X=I*PSIZE/XINC
        Y=PSIZE*(P(IWIN1+I,ISEG)-YZERO)/YINC
18610   CALL PLOT(X,Y,2)
        CALL PLOT(0,-PSIZE/2.,-3)
        XDS=(XMAX-XMIN)/PSIZE
        XSP=PSIZE*XTMI/(XMAX-XMIN)
        CALL FFAXIS(0.,0.,%REF(XLAB),-60,PSIZE,0.,XMIN,XDS,XSP,1,1.,1)
        YDS=(YMAX-YMIN)/PSIZE
        YSP=PSIZE*YTMI/(YMAX-YMIN)
        CALL FFAXIS(0.,0.,%REF(YLAB),60,PSIZE,90.,YMIN,YDS,YSP,1,1.,1)
        CALL TEXT(0.5,PSIZE+0.5,0.1,TITLE,0.)
        CALL PLOT(0,0,999)
        CALL PLOTNOW(IMSG)
        IF(IMSG.EQ.0) THEN
                CALL LIB$SIGNAL(MAG_COM)        ! Print an error message
                RETURN
        END IF
186     FORMAT (1X,'WAVEFORM BUFFER NO.?(0=MAIN)')
187     FORMAT (I5)
        RETURN
C
C
C
C
```

```
C
C       THIS ROUTINE READS DATA FROM A BASIC SCATTERING CODE CALCULATION
C
C
        ENTRY BSC
        CALL BSCREA(P,COM_UNIT)
        FLTP=1.
        RETURN
C
C
C
C
C
C
C
C
C
C
C       THIS ROUTINE ATTACHES A SMOOTH CUTOFF TAIL TO THE SPECTRUM
C        IN ORDER TO REDUCE THE GIBBS PHENOMENOM
C
C
C       FROM LEEPER'S COSINE ROLOFF 18FEB83 IN [LEEPER.X]DUMPZ.FOR
C
        ENTRY WND
179     WRITE(IOUT,*)
     +          'INPUT HARMONICS;START,END,TYPE OF WINDOW'
        WRITE(IOUT,*)
     +          'TYPE:0=HANNING,1=HAMMING,2=GAUSSIAN, 0,N,M,=TEST'
        READ(COM_UNIT,*) IFS,IFE,ITYP
        WRITE(LOG_UNIT,*) IFS,IFE,ITYP                          ! Log the input
        IF(IFS.GE.IFE) THEN
                CALL LIB$SIGNAL(MAG_COM)        ! Print an error message
                RETURN
        END IF
        IF(ITYP.EQ.2) THEN
                WRITE(IOUT,*) 'INPUT ALPHA'
        END IF
        IF(ITYP.EQ.2) THEN
                READ(COM_UNIT,*) ALPHA
                WRITE(LOG_UNIT,*) ALPHA                         ! Log the input
        END IF
        PI=3.1415927
180     NW=IFE-IFS+1                !( = # POINTS, ODD OR EVEN )
        XN2=NW/2.
        IF(XN2.NE.INT(XN2))GO TO 178
        IFE=IFE+1
        GO TO 180
178     IN2=XN2
        IF(IFS.NE.0)GO TO 190
        DO 189 I=1,IS
        P(I+IS,1)=0.
189     P(I,1)=102.4                !FILLS P ARRAY WITH UNITY FOR TEST
        GO TO 179
190     DO 198 I=IFS,IFE
        N=I-IFS
C       WRITE(IOUT,*) I
        WFACT=0.5*(1.-COS(2*PI*N/NW))                 !HANNING
        IF(ITYP.EQ.1) WFACT=.54-.46*COS(2*PI*N/NW)    !HAMMING
        IF(ITYP.NE.2) GO TO 1195
        N=N-IN2
        AVAR=-.5*(ALPHA*N/IN2)**2
        WFACT=EXP(AVAR)                  !GAUSSIAN
1195    IF(WFACT.EQ.0) WFACT=3.E-6
        P(I,1)=P(I,1)/10.24-10.          !=20LOG(ORIGINAL VOLTAGE)
        P(I,1)=10.**(P(I,1)/20.)         !=LINEAR VOLTAGE
```

```
      P(I,1)=P(I,1)*WFACT           !WEIGHT WITH SHIFTED COSINE
198   P(I,1)=10.24*(10.+20.*ALOG10(P(I,1)))
      IFE=IFE+1
      IFS=IFS-1
      DO 199 I=IFE,IS
199   P(I,1)=-1024.
      DO 188 I=1,IFS
188   P(I,1)=-1024.
      RETURN
C*******FILL REMAINING P(K,1) WITH -110dB = (-1024/10.24)-10.
C
C
C
C
C
C     GATE IN THE FREQ DOMAIN ROUTINE:FGT
C     STARTS AT HARMONIC N
C     ATTENUATES AT X DB PER HARMONIC
C
C
      ENTRY FGT
      WRITE (IOUT,191)
191   FORMAT(' HARMONIC FOR START HIGH FREQ CUTOFF ',$)
      READ (COM_UNIT,200) IHAR
      WRITE (LOG_UNIT,200) IHAR                          ! log the input
      WRITE(IOUT,192)
192   FORMAT(' HIGH FREQ ROLL-OFF IN DB PER HARMONIC',$)
      READ (COM_UNIT,201) XDB
      WRITE (LOG_UNIT,201) XDB                           ! log the input
      WRITE (IOUT,193)
193   FORMAT(' HARMONIC FOR START OF LOW FREQ CUTOFF ',$)
      READ (COM_UNIT,200) ILHAR
      WRITE (LOG_UNIT,200) ILHAR                         ! log the input
      WRITE (IOUT,194)
194   FORMAT(' LOW FREQ ROLLOFF IN DB PER HARMONIC ',$)
      READ (COM_UNIT,201) YDB
      WRITE (LOG_UNIT,201) YDB                           ! log the input
      DO 195 I=IHAR,IS
      FHAR=FLOAT(I-IHAR)
      P(I,1)=P(I,1)-10.24*XDB*FHAR
      IF(P(I,1).LT.-1024.) P(I,1)=-1024.
195   CONTINUE
      DO 196 I=1,ILHAR
      FHAR=FLOAT(ILHAR-I)
      P(I,1)=P(I,1)-10.24*YDB*FHAR
      IF(P(I,1).LT.-1024.)P(I,1)=-1024.
196   CONTINUE
200   FORMAT(I5)
201   FORMAT(F10.2)
      RETURN
C
C
C     TIME DOMAIN INTEGRATE ROUTINE
C
      ENTRY INTEG
      IF(IDS(1).NE.0) THEN
              CALL LIB$SIGNAL(MAG_COM)              ! Print an error message
              RETURN
      END IF
      PIZ=2.*PI/ISIZE
      P(1,1)=P(1,1)*PIZ
      DO 210 N=2,ISIZE
210   P(N,1)=P(N-1,1)+P(N,1)*PIZ
      RETURN
C
C
```

```
C
C
C       TIME DOMAIN DIFFERENTIATE ROUTINE
C
        ENTRY DIF
        IF(IDS(1).NE.0) THEN
                CALL LIB$SIGNAL(MAG_COM)               ! Print an error message
                RETURN
        END IF
        PE=P(ISIZE,1)
        DO 220 N=2,ISIZE
        NN=ISIZE+2-N
220     P(NN,1)=(P(NN,1)-P(NN-1,1))*ISIZE/(2.*PI)
        P(1,1)=(P(1,1)-PE)*ISIZE*0.5/PI
        RETURN
C
C
C       STATEMENT 550 32583
C
C
C       RELABLE COMMAND
C
        ENTRY RLB
        WRITE (IOUT,225)
        WRITE (IOUT,231) ITITLE                        ! sho the present label
225     FORMAT(/,' OLD TITLE BLOCK: ')
        WRITE (IOUT,230)                                       ! prompt
230     FORMAT(/,' NEW TITLE BLOCK: ')
        READ (COM_UNIT,231) ITITLE                     ! read the new label
        WRITE (LOG_UNIT,231) ITITLE                    ! log the input
231     FORMAT(50A1)
        RETURN
C
C
C       NORMALIZING TIME DOMAIN DATA TO ZERO MEAN
C
C
        ENTRY NOR
        RMEAN=0.
        DO 3111 I=1,ISIZE
3111    RMEAN=P(I,1)+RMEAN
        RMEAN=RMEAN/ISIZE
        DO 3112 I=1,ISIZE
3112    P(I,1)=P(I,1)-RMEAN
        RETURN
C
C
C
C
C       CLEAR THE MAIN BUFFER
C
C
        ENTRY CLR
        DOMAIN = ' '
        LINE1(1) = 0
        DO 3113 I=1,ISIZE
3113    P(I,1)=0.
        RETURN
C
C       POINT SMOOTH ROUTINE
C
C
C
        ENTRY PSM
        IF(FLTP.EQ.1) GO TO 4051
        WRITE (IOUT,4001)
```

```
4001     FORMAT(' FIRST BAD POINT INTEGER= ',$)
         READ (COM_UNIT,4003) IQ
         WRITE (LOG_UNIT,4003) IQ                                ! log the input
         WRITE (IOUT,4002)
4002     FORMAT(' LAST BAD POINT INTEGER= ',$)
4003     FORMAT (I5)
         READ (COM_UNIT,4003) IR
         WRITE (LOG_UNIT,4003) IR                                ! log the input
         IF(IQ.LT.3) THEN
                 CALL LIB$SIGNAL(MAG_COM)
                 RETURN
         END IF
         IF(IR.LT.3) THEN
                 CALL LIB$SIGNAL(MAG_COM)
                 RETURN
         END IF
         IF(IQ.GT.ISIZE-2) THEN
                 CALL LIB$SIGNAL(MAG_COM)
                 RETURN
         END IF
         IF(IR.GT.ISIZE-2) THEN
                 CALL LIB$SIGNAL(MAG_COM)
                 RETURN
         END IF
         IF (IR.LT.IQ) THEN
                 CALL LIB$SIGNAL(MAG_COM)
                 RETURN
         END IF
         PSQ=P(IQ-1,1)
         PSN=IR-IQ+2
         PSS1=P(IQ-1,1)-P(IQ-2,1)
         PSS2=P(IR+2,1)-P(IR+1,1)
         PSD1=P(IR+1,1)-P(IQ-1,1)
         PSC=3.*PSD1/(PSN*PSN)-(2.*PSS1+PSS2)/PSN
         PSD=(PSS2+PSS1)/(PSN*PSN)-2.*PSD1/(PSN*PSN*PSN)
         PSA=PSQ
         PSB=PSS1
         IPSN=IR-IQ+1
         DO 4010 I=1,IPSN
4010     P(IQ+IPSN-1,1)=PSA+PSB*I+PSC*I*I+PSD*I*I*I
         GO TO 4075
4051     WRITE (IOUT,4052)
4052     FORMAT(' FIRST BAD HARMONIC= ',$)
         READ (COM_UNIT,4003) IQ
         WRITE (LOG_UNIT,4003) IQ                                ! log the input
         WRITE (IOUT,4053)
4053     FORMAT(' LAST BAD HARMONIC= ',$)
         READ (COM_UNIT,4003) IR
         WRITE (LOG_UNIT,4003) IR                                ! log the input
         IF (IQ.LT.3) THEN
                 CALL LIB$SIGNAL(MAG_COM)                ! Print an error message
                 RETURN
         END IF
         IF(IR.LT.3) THEN
                 CALL LIB$SIGNAL(MAG_COM)                ! Print an error message
                 RETURN
         END IF
         IF(IQ.GT.ISM2) THEN
                 CALL LIB$SIGNAL(MAG_COM)
                 RETURN
         END IF
         IF(IR.GT.ISM2) THEN
                 CALL LIB$SIGNAL(MAG_COM)                ! Print an error message
                 RETURN
         END IF
         IF(IR.LT.IQ) THEN
```

```
              CALL LIB$SIGNAL(MAG_COM)
              RETURN
        END IF
        RT2=SQRT(2.)
        DO 4056 N=IQ-2,IR+2
        NN=IS+N
        AMP=(P(N,1)/10.24)-10.
        PHAS=PI*P(NN,1)/512.
        A(N)=CMPLX(COS(PHAS),SIN(PHAS))*RT2*10.**(AMP*.05)
4056    WRITE(IOUT,*) N,AMP,PHAS,A(N)
        ASQ=A(IQ-1)
        ASN=IR-IQ+2
        ASS1=A(IQ-1)-A(IQ-2)
        ASS2=A(IR+2)-A(IR+1)
        ASD1=A(IR+1)-A(IQ-1)
        ASC=3*ASD1/(ASN*ASN)-(2.*ASS1+ASS2)/ASN
        ASD=(ASS2+ASS1)/(ASN*ASN)-2.*ASD1/(ASN*ASN*ASN)
        ASA=ASQ
        ASB=ASS1
        WRITE(IOUT,*) ASA,ASB,ASC,ASD
        IASN=IR-IQ+1
        DO 4060 I=1,IASN
        IN=IQ-1+I
        FI=FLOAT(I)
        A(IN)=ASA+ASB*FI+ASC*FI*FI+ASD*FI*FI*FI
        WRITE(IOUT,*) A(IN)
        X=CABS(A(IN))
        IF(X.LT.1.E-20)X=1.E-20
        P(IN,1)=10.24*(10.+20.*ALOG(X*RT2))
        IF(X.EQ.0) P(IN+IS,1)=0.
4060    IF(X.NE.0)P(IN+IS,1)=512.*ATAN2(AIMAG(A(IN)),REAL(A(IN)))/PI
4075    CONTINUE
        RETURN
C
C
C
C
C
C
C
C       YSHIFT COMMAND
C
C
        ENTRY YSH
        WRITE (IOUT,251)
251     FORMAT(' YSHIFT IN UNITS(-2048<Y<2048)= ',$)
        READ (COM_UNIT,252) IY
        WRITE (LOG_UNIT,252) IY                              ! log the input
252     FORMAT (I5)
        Y=FLOAT(IY)
        DO 255 I=1,ISIZE
255     P(I,1)=P(I,1)+Y
        RETURN
C
C
C       ROTATE COMMAND
C
C
        ENTRY ROT
        WRITE (IOUT,260)
260     FORMAT (' ROTATE BY INCREMENTS OF: ',$)
        READ (COM_UNIT,261) IX
        WRITE (LOG_UNIT,261) IX                              ! log the input
261     FORMAT (I5)
        DO 265 I=1,ISIZE
        J=I+IX
```

```
      IF(J.GT.ISIZE)J=J-ISIZE
      IF(J.LT.1)J=J+ISIZE
265   Q(J)=P(I,1)
      DO 267 I=1,ISIZE
267   P(I,1)=Q(I)
      RETURN
C
C
C     ROUTINE TO DOWNCONVERT A SPECTRUM TO A DUAL-POLARITY ENVELOPE
C     USER CHOOSES THE HARMONIC NUMBER TO CALL HIS "CENTER FREQUENCY"
C     WHICH GETS CONVERTED TO THE DC TERM
C     WORKS ON A FREQUENCY SPECTRUM IN MAIN BUFFER,RESULT TO MAIN BUFFER
C
C
C
C
C
C
      ENTRY DCV
      IF (FLTP.EQ.0) THEN
              CALL LIB$SIGNAL(MAG_COM)          ! Print an error message
              RETURN
      END IF
      WRITE(IOUT,*) 'INPUT THE HARMONIC NUMBER TO BE MOVED TO DC'
      READ (COM_UNIT,*) IHRDC
      WRITE (LOG_UNIT,*) IHRDC                                 ! log the input
      IF (IHRDC.GT.IS) THEN
              CALL LIB$SIGNAL(MAG_COM)          ! Print an error message
              RETURN
      END IF
      DO 5110 N=1,ISIZE
5110  Q(N)=P(N,1)
      DO 5120 N=1,IS
      Q(N)=(Q(N)/10.24)-10.
5120  Q(N+IS)=PI*Q(N+IS)/512.
      DO 5190 N=1,IS
      M=N-1
      BCX=0.
      CCX=0.
      P(N+IS,1)=0.
      IF(IHRDC+M.GT.IS) GO TO 5130
      BCX=CMPLX(COS(Q(IHRDC+M+IS)),SIN(Q(IHRDC+M+IS)))*10.**(Q(IHRDC+M)*.05)
5130  IF(IHRDC-M.LT.1) GO TO 5140
      AEXP=10.**(0.05*Q(IHRDC-M))
      CCX=CMPLX(COS(Q(IHRDC-M+IS)),-SIN(Q(IHRDC-M+IS)))*AEXP
5140  DCX=BCX+CCX
      X=CABS(DCX)
      IF(X.LT.1.E-20) X=1.E-20
      P(N,1)=10.24*(10.+20.*ALOG10(X))
      IF(X.LE.1.E-20) GO TO 5190
      P(N+IS,1)=512.*ATAN2(AIMAG(DCX),REAL(DCX))/PI
5190  CONTINUE
      RETURN
C
C
C
C
C
C
C
C     ROUTINE TO SET UP THE PARAMETERS FOR A TWO DIMENSIONAL IMAGE
C
C
C
      ENTRY CMI
      WRITE(IOUT,*) 'NUMBER OF VV TIME DOMAIN WAVEFORMS TO BE USED?'
```

```
      READ (COM_UNIT,*) NUMB(1)
      WRITE (LOG_UNIT,*) NUMB(1)                        ! log the input
      DO 5510 I=1,NUMB(1)
      WRITE (IOUT,5503) I
5503  FORMAT(' BUFFER NUMBER FOR VV FILE # ',I5)
      READ (COM_UNIT,*) BUFN(1,I)
      WRITE (LOG_UNIT,*) BUFN(1,I)                      ! log the input
      BUFN(1,I)=I+BUFN(1,I)
      WRITE (IOUT,5505) I
5505  FORMAT(' LOOK ANGLE IN DEGREES FOR FILE # ',I5)
      READ (COM_UNIT,*) ANG(1,I)
      WRITE (LOG_UNIT,*) ANG(1,I)                       ! log the input
      ANG(1,I)=ANG(1,I)*PI/180.
      WRITE (IOUT,5507) I
5507  FORMAT(' CENTER ELEMENT NUMBER FOR FILE # ',I5)
      READ (COM_UNIT,*) CNTR(1,I)
5510  WRITE (LOG_UNIT,*) CNTR(1,I)                      ! log the input
      WRITE(IOUT,*) 'NUMBER OF HH TIME DOMAIN WAVEFORMS TO BE USED?'
      READ (COM_UNIT,*) NUMB(2)
      WRITE (LOG_UNIT,*) NUMB(2)                        ! log the input
      DO 5520 I=1,NUMB(2)
      WRITE (IOUT,5513) I
5513  FORMAT(' BUFFER NUMBER FOR HH FILE # ',I5)
      READ (COM_UNIT,*) BUFN(2,I)
      WRITE (LOG_UNIT,*) BUFN(2,I)                      ! log the input
      BUFN(2,I)=I+BUFN(2,I)
      WRITE (IOUT,5505) I
      READ (COM_UNIT,*) ANG(2,I)
      WRITE (LOG_UNIT,*) ANG(2,I)                       ! log the input
      ANG(2,I)=ANG(2,I)*PI/180.
      WRITE (IOUT,5507) I
      READ (COM_UNIT,*) CNTR(2,I)
5520  WRITE (LOG_UNIT,*) CNTR(2,I)                      ! log the input
      WRITE(IOUT,*) ' NUMBER OF HV TIME DOMAIN WAVEFORMS TO BE USED?'
      READ (COM_UNIT,*) NUMB(3)
      WRITE (LOG_UNIT,*) NUMB(3)                        ! log the input
      DO 5530 I=1,NUMB(3)
      WRITE (IOUT,5523) I
5523  FORMAT(' BUFFER NUMBER FOR HV FILE # ',I5)
      READ (COM_UNIT,*) BUFN(3,I)
      WRITE (LOG_UNIT,*) BUFN(3,I)                      ! log the input
      BUFN(3,I)=I+BUFN(3,I)
      WRITE (IOUT,5505) I
      READ (COM_UNIT,*) ANG(3,I)
      WRITE (LOG_UNIT,*) ANG(3,I)                       ! log the input
      ANG(3,I)=ANG(3,I)*PI/180.
      WRITE (IOUT,5507) I
      READ (COM_UNIT,*) CNTR(3,I)
5530  WRITE (LOG_UNIT,*) CNTR(3,I)                      ! log the input
      RETURN
C
C
C
C
C     ROUTINE TO FORM THE IMAGE FOR ONE POLARIZATION FROM TIME DOMAIN
C     WAVEFORMS AS SET UP BY THE CMI COMMAND
C
C
      ENTRY IMG

      WRITE(IOUT,*) 'SIZE OF THE IMAGE,(1 TO 4096)=?'   ! get the window size
      READ (COM_UNIT,*) IMSIZE
      WRITE (LOG_UNIT,*) IMSIZE                     ! log the input
      FIMINC=FLOAT(IMSIZE/100)                ! the size of the increment
      PNUM=FIMINC                   ! figure out the number of harmonics to
      IF (MOD(PNUM,2) .EQ. 0) THEN  !    be averaged for an array value
```

```
              PNUM=PNUM+1                           ! This number must be odd
         END IF
         IF (PNUM .LT. 3) THEN     ! When PNUM is 3 the weights of the other
              PNUM=3                                      !two numbers are 0
         END IF
         WRITE(IOUT,*) 'LOOK ANGLE OF THE IMAGE,DEGREES?'        ! get the
C    rotation angle of the image
         READ (COM_UNIT,*) ALANGL
         WRITE (LOG_UNIT,*) ALANGL                              ! log the input
         BLANGL=ALANGL*PI/180.
         WRITE(IOUT,*) 'POLARIZATION OF THE IMAGE,(1=VV,2=HH,3=HV,4=ALL)'! which
C polarizations will be used?
         READ (COM_UNIT,*) IIPOL
         WRITE (LOG_UNIT,*) IIPOL                                  ! log the input
         IPOL=IIPOL
         IF(IIPOL.NE.4) GO TO 5660         ! if not using all polarizations then
         DO 5699 IIPOL=1,3                 !        just do the individual pol.
5660     DO 5690 I=1,100                            ! figure out the X coordinate
         X=(I-50.5)*FIMINC
         DO 5680 J=1,100                            ! figure out the Y coordinate
         Y=(J-50.5)*FIMINC
         XX=X*COS(BLANGL)+Y*SIN(BLANGL)                            ! the
C X coordinate taking the rotation angle into account
         YY=-X*SIN(BLANGL)+Y*COS(BLANGL)                           ! the Y
C coordinate taking the rotation angle into account
         ARRAY(IIPOL,I,J)=0.                             ! clear the image array
         DO 5670 K=1,NUMB(IIPOL)
         XXX=XX*COS(ANG(IIPOL,K))+YY*SIN(ANG(IIPOL,K))    !       the X coordinate
         YYY=-XX*SIN(ANG(IIPOL,K))+YY*COS(ANG(IIPOL,K))   !       the Y coordinate
         IPOINT=YYY+CNTR(IIPOL,K)                       !the point of intersection
         IF(IPOINT.LT.0) IPOINT=IPOINT+ISIZE    ! the time domain waveform
C repeats throughout time
         IF(IPOINT.GT.ISIZE) IPOINT=IPOINT-ISIZE
         VALUE=0
         DO ELEMENT=(IPOINT-((PNUM-1)/2)),(IPOINT+((PNUM-1)/2))  ! take
C the points around the center point
              ELEM=ELEMENT
              WEIGHT=1+COS((2*(ELEM-IPOINT)*PI)/(PNUM-1))     !use a weighted
C shifted cosine average
              IF(ELEM.LT.0) ELEM=ELEM+ISIZE   ! the time domain waveform
C repeats throughout time
              IF(ELEM.GT.ISIZE) ELEM=ELEM-ISIZE
              PVALUE=WEIGHT*P(ELEM,BUFN(IIPOL,K))
              VALUE=VALUE+PVALUE
         END DO
         VALUE=VALUE/(PNUM-1)
         ARRAY(IIPOL,I,J)=ARRAY(IIPOL,I,J)+VALUE/NUMB(IIPOL)
5670     CONTINUE
5680     CONTINUE
5690     CONTINUE
5699     CONTINUE
C        WRITE THE IMAGE ARRAY TO AN OUTPUT FILE
         WRITE(IOUT,*)'Do you want to store the image? Y=1,N=0 '
         READ (COM_UNIT,*) ANS
         WRITE(LOG_UNIT,*)ANS
         IF(ANS.EQ.0)RETURN
         WRITE(IOUT,*) 'Enter the output file name'
         READ(COM_UNIT,10)FNAME
         WRITE(LOG_UNIT,10)FNAME
10       FORMAT(A40)
C
         WRITE(IOUT,*) 'Enter the freq. increment of the signal in MHz'
         READ(COM_UNIT,*) FER
         WRITE(LOG_UNIT,*)FER
         PER=1./FER*1000             !Period of the time signal
C
```

```
      OPEN(UNIT=31,FILE=FNAME,TYPE='NEW',
     +         FORM='UNFORMATTED')

      WRITE(31)IMSIZE,PER
77    DO 99 I=1,100
      DO 99 J=1,100
      WRITE(31) ARRAY(IPOL,I,J)
99    CONTINUE
      RETURN
C
C
C
C
C     THIS ROUTINE PLOTS AN ISOMETRIC VIEW OF A SINGLE POLARIZATION
C     TWO-DIMENSIONAL TARGET IMAGE ON THE PLOT DEVICE IN ISOMETRIC
C     FORM WITH NO SHADOWING
C
C
C
      ENTRY PIM
      WRITE(IOUT,*) 'TYPE IN A POLARIZATION INDEX(1=VV,2=HH,3=HV)'
      READ (COM_UNIT,*) IIPOL
      WRITE (LOG_UNIT,*) IIPOL                            ! log the input
      IF(IIPOL.GT.3) THEN
              CALL LIB$SIGNAL(MAG_COM)        ! Print an error message
              RETURN
      END IF
      IF(IIPOL.LT.1) THEN
              CALL LIB$SIGNAL(MAG_COM)            ! Print an error message
              RETURN
      END IF
      CALL VPLOTS(0,0,0)
      CALL PLOT(4.,5.,-3)
      DO 5790 I=1,100
      DO 5790 J=1,100
      X=(J-20.5)*0.1
      Y=(I-20.5)*0.1
      XX=0.866*(X+Y)
      YY=0.5*(Y-X)+ARRAY(IIPOL,I,J)/256.
      IF(J.EQ.1) CALL PLOT(XX,YY,3)
      IF(J.NE.1) CALL PLOT(XX,YY,2)
5790  CONTINUE
      CALL PLOT(0,0,999)
      CALL PLOTNOW(IMSG)
      RETURN
C
C
C
C
C
C
C
C


      ENTRY FRDC
      CALL FRD(P,COM_UNIT)
      FLTP=1
      RETURN
C
C
C
C     THIS COMMAND READS NEW MEASUREMET
C
C
      ENTRY RDFL(HEAD, LINE1, LINE2, LINE3)
```

```
      DOMAIN='FREQ'
      CALL FRD1(P,EFLAG)
      IF (EFLAG) THEN                                 ! if an error occurred
              EFLAG = .FALSE.                         ! reset error flag
      ELSE
              FLTP=1
      END IF
      RETURN
C
C
C
C     READ THE CARD FILE
C
C     ENTRY CARDC
C     CALL CARD(P)
C     RETURN
C
C
C
C
C
C     SHOW BUFFER ROUTINE:
C             This routine shows the contents of
C         all of the buffers.
C
      ENTRY SHO_BUF
      DO I=1,40
              IF (BUFFERS(I,1) .NE. 0) THEN
                      WRITE(IOUT,6105) (I, DOM(I))
                      WRITE(IOUT,6110) (BUFFERS(I,J), J=1,30)
              END IF
      END DO
6105  FORMAT('0', I4, 3X, A4)
6110  FORMAT(4X, 60A2)
C
C
C
      END
C   ***********************************************
C   ***************          **              *******************
C   **********  ***********   ***************   *** *** ** * *  *
      SUBROUTINE FRD(P,COM_UNIT)
      COMPLEX BA(201),KLA,CA(2049)
      CHARACTER*20 INFILE
      INTEGER*4 COM_UNIT
      REAL FA(2049),P(2048,11)
      DO 3410 I=1,1024
      P(I+1024,1)=0.
3410  P(I,1)=-1024.
      DO 7825 I=1,2049
      CA(I)=0.
7825  FA(I)=0.
      WRITE(IOUT,*) 'INPUT MAJOR AXIS DIMENSION (INCHES)'
      READ (COM_UNIT,*) DLE
      WRITE (LOG_UNIT,*) DLE                          ! log the input
      FLOW=100.
      FHIGH=0.
      IBASE=0
      DLE=DLE*2.54
      TWOPI=ATAN(1.)*8.
      WRITE(IOUT,*) '*** TYPE RETURN IF THERE IS NO SUCH FILE ***'
      WRITE(IOUT,*) 'NOW INPUT THE 1-2G FILE NAME  '
      READ (COM_UNIT,7823) INFILE
      WRITE (LOG_UNIT,7823) INFILE                            ! log the input
7823  FORMAT(A20)
      IF(INFILE.EQ.' ')GO TO 3350
```

```
      IF(FLOW.GT.1.)FLOW=1.
      IF(FHIGH.LT.2.)FHIGH=2.
      CALL TDATA(BA,INFILE)
      DO 3360 I=1,201
      CA(I)=BA(I)
3360  FA(I)=(1.+(I-1)/200.)*TWOPI*DLE/3.
      IBASE=IBASE+200
3350  WRITE(IOUT,*) 'INPUT THE 2-4G FILE NAME'
      READ (COM_UNIT,7823) INFILE
      WRITE (LOG_UNIT,7823) INFILE                        ! log the input
      IF(INFILE.EQ.' ')GO TO 3380
      IF(FLOW.GT.2.)FLOW=2.
      IF(FHIGH.LT.4.)FHIGH=4.
      CALL TDATA(BA,INFILE)
      DO 9210 I=1,201
      CA(I+IBASE)=BA(I)
9210  FA(I+IBASE)=(2.+(I-1)/100.)*TWOPI*DLE/3.
      IBASE=IBASE+200
3380  WRITE(IOUT,*) 'INPUT THE 4-8G FILE NAME'
      READ (COM_UNIT,7823) INFILE
      WRITE (LOG_UNIT,7823) INFILE                        ! log the input
      IF(INFILE.EQ.' ')GO TO 3390
      IF(FLOW.GT.4.)FLOW=4.
      IF(FHIGH.LT.8.)FHIGH=8.
      CALL TDATA(BA,INFILE)
      DO 9220 I=1,201
      CA(I+IBASE)=BA(I)
9220  FA(I+IBASE)=(4.+(I-1)/50.)*TWOPI*DLE/3.
      IBASE=IBASE+200
3390  WRITE(IOUT,*) 'INPUT THE 8-12G FILE NAME'
      READ (COM_UNIT,7823) INFILE
      WRITE (LOG_UNIT,7823) INFILE                        ! log the input
      IF(INFILE.EQ.' ')GO TO 3400
      IF(FLOW.GT.8.)FLOW=8.
      IF(FHIGH.LT.12.)FHIGH=12.
      CALL TDATA(BA,INFILE)
C     NOTE THAT THIS DO LOOP RUNS 201 TIMES
      DO 9230 I=1,201
      CA(I+IBASE)=BA(I)
9230  FA(I+IBASE)=(8.+(I-1)/50.)*TWOPI*DLE/3.
3400  I=1
      IF(FLOW.GE.FHIGH)RETURN
      KLOW=INT(TWOPI*FLOW*DLE/3.)+1
      KHIGH=INT(TWOPI*FHIGH*DLE/3.)
      DO 7720 K=KLOW,KHIGH
7740  IF(K.GE.FA(I).AND.K.LE.FA(I+1))GO TO 7730
      I=I+1
      GO TO 7740
7730  IF(K.GT.1024)GO TO 7777
      KLA=(CA(I+1)-CA(I))/(FA(I+1)-FA(I))*(K-FA(I))+CA(I)
      KLA=KLA*2./(SQRT(TWOPI/2.)*DLE)
      P(K,1)=10.24*(10.+20.*ALOG10(CABS(KLA)))
7720  P(K+1024,1)=1024.*ATAN2(AIMAG(KLA),REAL(KLA))/TWOPI
7777  RETURN
      END
C
C
C
      SUBROUTINE BUFSTR(IHDSZ,IDSSZ,ISIZE,IB,HEAD,P,IDS)
      INTEGER*2 HEAD(256,31)
      DIMENSION P(4096,31),IDS(31)
      IC=IB+1
      DO 10 I=1,IHDSZ
10    HEAD(I,IC)=HEAD(I,1)
      DO 20 I=1,ISIZE
20    P(I,IC)=P(I,1)
```

```
      IDS(IC)=IDS(1)
      RETURN
      END
C
C
C
      SUBROUTINE BUFRD(IHDSZ,IDSSZ,ISIZE,IB,HEAD,P,IDS)
      INTEGER*2 HEAD(256,31)
      DIMENSION P(4096,31),IDS(31)
      IC=IB+1
      DO 10 I=1,IHDSZ
10    HEAD(I,1)=HEAD(I,IC)
      DO 20 I=1,ISIZE
20    P(I,1)=P(I,IC)
      IDS(1)=IDS(IC)
      RETURN
      END
C
C
C
      SUBROUTINE TDATA(CA,INFILE)
      COMPLEX*8 CA(201)
      CHARACTER*20 INFILE
      INTEGER*2 BUFF(1024)
      REAL*4 AM(201),PH(201)
      EQUIVALENCE (AM(1),BUFF(53)),(PH(1),BUFF(455))
      INCLUDE 'SYS$LIBRARY:FORIOSDEF'
810   OPEN(UNIT=19,NAME=INFILE,STATUS='OLD',
     +        DEFAULTFILE=DEF,IOSTAT=IERR,ERR=8100)
      DO 20 I=1,1024,256
      J=I+255
20    READ(19,30)(BUFF(K),K=I,J)
30    FORMAT(256A2)
      DO 70 I=1,201
      AM(I)=10**(AM(I)/20.)
70    CA(I)=CMPLX(AM(I)*COS(PH(I)),AM(I)*SIN(PH(I)))
      GO TO 80
8100  IF(IERR.EQ.FOR$IOS_FILNOTFOU)THEN
      WRITE(TERM_UNIT,1112) INFILE
1112  FORMAT(' FILE : ',A20,' DOSE NOT EXIST',//,' ENTER FILENAME AGAIN')
      ELSE IF (IERR.EQ.FOR$IOS_FILNAMSPE)THEN
      WRITE(TERM_UNIT,*) 'FILE:',INFILE,'WAS BAD,    ENTER NEW FILENAME'
      ELSE
      WRITE(TERM_UNIT,*) 'UNRECOVERABLE ERROR , CODE =',IERR
      STOP
      ENDIF
      GO TO 810
80    CLOSE(UNIT=19,DISP='SAVE')
      RETURN
      END
C
C
C
C
C     CONTROLLER
C            This subroutine controls the input and output
C         devices of the program.
C
C
      SUBROUTINE CONTROLLER
C
      INCLUDE 'USER2:[DURAL.CIMAG2]FTRN.FOR'
      INCLUDE 'USER2:[DURAL.CIMAG2]MAGCMN2.FOR'
      Include 'USER2:[DURAL.CIMAG2]MAGCMN.FOR'
      INCLUDE 'USER2:[DURAL.CIMAG2]HEADER.CMN'
      INCLUDE 'USER2:[DURAL.CIMAG2]MSGBLK.FOR'   ! error message common block
```

```
C
      INTEGER*4 FOR_RETCODE                     ! fortran return code
      INTEGER*4 RETCODE                         ! return code
      INTEGER*4 SS$_NORMAL                      ! "normal" return code
      INTEGER*4
     +        LIB$GET_LUN ,                     ! 'get LU#' RTL routine
     +        LIB$FREE_LUN                      ! 'free LU#' RTL routine
C
      INTEGER*4 COM_STACK(20)                  ! the command units stack
      INTEGER*4 TOP_COM / 0 /                  ! top of the command stack
      CHARACTER*40 DEF_STACK(20)               ! default stack
      INTEGER*4 TOP_DEF / 0 /                  ! top of default stack
C
      CHARACTER*70 NAME                        ! name of the file
C
      PARAMETER (SS$_NORMAL = '00000001'X)
C
C
C
C
C
C     WRI:
C             ROUTINE TO WRITE TO DISK
C
      ENTRY WRI(HEAD, LINE1, LINE2, LINE3)
      WRITE(IOUT,2)
2     FORMAT(' FILE NAME ? ',$)
      READ (COM_UNIT,4) FILNM
      WRITE (LOG_UNIT,4) FILNM                          ! log the input
4     FORMAT(A50)
      OPEN(UNIT=1,ERR=6,FILE=FILNM,TYPE='NEW',
     +        FORM='UNFORMATTED')
      GOTO 8
6     CALL LIB$SIGNAL(MAG_COM)             ! Print an error message
      RETURN
8     WRITE(IOUT,*) 'DO YOU WANT TO CHANGE THE FILE HEADER Y=1, N=0'
      READ (COM_UNIT,*) IYN
      WRITE (LOG_UNIT,*) IYN                            ! log the input
      IF(IYN.EQ.1) CALL RLB                        ! the relabel routine
      WRITE(1) (HEAD(I,1),I=1,256)
      WRITE(1) (P(I,1),I=1,ISIZE)
      CLOSE(UNIT=1)
      RETURN
C
C
C
C
C     FILE:
C             This command gives control of the program to
C         a command file. The output however will still go
C         wherever IOUT is set.
C
      ENTRY FILE
C
C
C
      RETCODE=LIB$GET_LUN( FILE_UNIT )    ! get the LU# for the command file
      IF (RETCODE .NE. SS$_NORMAL) THEN        ! if no errors occurred
              CALL LIB$STOP( %VAL(RETCODE) )
      END IF
      IF(PROC_FLAG)THEN
              NAME='USER2:[DURAL.CIMAG2]PROC2.DAT'
      ELSE
              WRITE(IOUT,10)                    ! prompt for file name
              READ(COM_UNIT,15) NAME            ! get the file name
      END IF
```

```
        OPEN(   UNIT=FILE_UNIT ,                    ! open the command file
     +          FILE=NAME ,
     +          DEFAULTFILE=DEF ,
     +          IOSTAT=FOR_RETCODE ,
     +          STATUS='OLD')
C
        IF (FOR_RETCODE .EQ. 29) THEN                        ! if file not found
                CALL LIB$SIGNAL(MAG_FILNOTFOU)               ! print error
                RETURN
        ELSE IF (FOR_RETCODE .NE. 0) THEN                    ! if not normal
                CALL LIB$SIGNAL(MAG_COM)                     ! Print an error messag
                RETURN
        END IF
C
        TOP_COM = TOP_COM + 1        ! push the old command unit onto the stack
        COM_STACK( TOP_COM ) = COM_UNIT
C
        TOP_DEF = TOP_DEF + 1                       ! push old def on stack
        DEF_STACK( TOP_DEF ) = DEF
C
        COM_UNIT = FILE_UNIT              ! give control to the file
C
C
C
10      FORMAT(1X, 'COMMAND FILE?', $)                       ! the name prompt
15      FORMAT( A )
20      FORMAT(1X,'ERROR IN RETRIEVING LU#')
C
        RETURN
C
C
C
C
C       BACK:
C               This command gives control back to
C            the unit that had control before this
C            one took over.
C
C
        ENTRY BACK
C
        IF (COM_UNIT .EQ. TERM_UNIT) THEN    ! if terminal is command input
                RETURN                      !  then ignore this command
        END IF
C
        FILE_UNIT = COM_UNIT                                 ! retrieve file LU#
        CLOSE( UNIT = FILE_UNIT )                            ! close the file
C
        COM_UNIT = COM_STACK( TOP_COM )  ! pop the last com_unit off the stack
        TOP_COM = TOP_COM - 1
C
        DEF = DEF_STACK( TOP_DEF )                           ! pop old def
        TOP_DEF = TOP_DEF - 1
C
        RETCODE = LIB$FREE_LUN( FILE_UNIT )        ! give LU# back to system
        IF (RETCODE .NE. SS$_NORMAL) THEN                         ! if error
                CALL LIB$STOP( %VAL( RETCODE ) ) ! then stop and give reason
        END IF
C
        IF (COM_UNIT .EQ. TERM_UNIT) THEN      ! if the terminal has  become
               WRITE(IOUT,25)                               !the command unit
        END IF                                              ! then tell the user
25      FORMAT( 1X, 'CONTROL HAS RETURNED TO THE TERMINAL')
        RETURN
C
C
```

```
C       DEF:
C               This command sets the default for all the
C            file I/O.
C
C
        ENTRY DEFFER
        WRITE(IOUT,30)                          ! ask user for the default
        READ(COM_UNIT,35) DEF
        WRITE (LOG_UNIT,35) DEF                         ! log the input
        IF (PROC_FLAG) THEN                     ! if defining a procedure
                DEF='USER2:[DURAL.CIMAG2]'     ! then all files accessed are
C  in this directory
        END IF
30      FORMAT(1X, 'DEFAULT?', $)
35      FORMAT(A40)
        RETURN
C
C
C       LOG:
C               This command copies all the user input
C            into a command file.
C
        ENTRY LOGGER
C
        RETCODE=LIB$GET_LUN( LOG_UNIT )         ! get the LU# for the log file
        IF (PROC_FLAG) THEN                     ! if defining a procedure
                NAME='USER2:[DURAL.CIMAG2]PROC.DAT' !this is the definition file
        ELSE
                WRITE(IOUT,40)                          ! prompt for file name
                READ(COM_UNIT,45) NAME                  ! get the file name
        END IF
        IF (RETCODE .EQ. SS$_NORMAL) THEN               ! if no errors occurred
                OPEN(   UNIT=LOG_UNIT ,                 ! open the log file
     +                  FILE=NAME ,
     +                  STATUS='UNKNOWN')
C
C
        ELSE
                WRITE(IOUT,50)
                CALL LIB$STOP(%VAL(RETCODE))
        END IF
C
40      FORMAT(1X, 'LOG FILE?', $)                      ! the name prompt
45      FORMAT( A )
50      FORMAT(1X,'ERROR IN RETRIEVING LU#')
C
        RETURN
C
C
C
C       STO_LOG:
C               Stop logging.
C
C
        ENTRY STO_LOG
C
        CLOSE( UNIT=LOG_UNIT )                          ! close the logging file
        RETCODE = LIB$FREE_LUN( LOG_UNIT )             ! give LU# back to system
        IF (RETCODE .NE. SS$_NORMAL) THEN               ! if error
                CALL LIB$STOP( %VAL( RETCODE ) )! then stop and give reason
        END IF
        LOG_UNIT = NULL_UNIT                            ! log to null device
        RETURN
C
C
        END
```

```
C
C
C       SUBROUTINE COMPLEX_COM:
C               This subroutine contains all of the complex
C           commands. These complex commands use the other
C           command routines in combinations to perform
C           more complex operations.
C
C
C
        SUBROUTINE COMPLEX_COM
        INCLUDE 'USER2:[DURAL.CIMAG2]FTRN.FOR'
        INCLUDE 'USER2:[DURAL.CIMAG2]MAGCMN.FOR'
        INCLUDE 'USER2:[DURAL.CIMAG2]MAGCMN2.FOR'       ! controls common block
C
        REAL            SEC             ! number of nanoseconds per division
        INTEGER*4       INC                             ! increment
        INTEGER*4       GWID                            ! width of a grid line
        INTEGER*4       PROC_UNIT                       ! LU# for defintion file
        INTEGER*4       LIST_UNIT                       ! LU# for list file
        INTEGER*4       NEW_UNIT        ! LU# for list of output file names
        INTEGER*4       PROC2_UNIT              ! The command procedure file
C
        INTEGER*4 FOR_RETCODE                           ! fortran return code
        INTEGER*4 PROCSTAT              ! status of a read from def. file
        INTEGER*4 LISTSTAT              ! status of a read from list file
        INTEGER*4 NEWSTAT       ! status of a read from output list file
        INTEGER*4 FOR_EOF / -1 /                        ! end of file code
C
        CHARACTER*80    OPER            ! input data from the definition file
        CHARACTER*1     REPLY                   ! answer to Y or N question
C
        CHARACTER*70    NAME                    ! name of the logging file
        CHARACTER*70    NEWNAME                         ! new file name
        CHARACTER*75    COMMAND         ! command sent to a spawned procedure
C
        CHARACTER*70    PROCNAME                        ! definition file name
        CHARACTER*70    LISTNAME                        ! data list file
        CHARACTER*70    OUTNAME                         ! output list name
C
C
C       CLR_BUF:
C               This routine clears all the buffers
C
C
        ENTRY CLR_BUF(HEAD, LINE1, LINE2, LINE3)
        CALL CLR                                        ! clear the main buffer
        DO NB=1,40                                      ! do for all the buffers
                IF (BUFFERS(NB,1) .NE. 0) THEN          ! if buffer is not empty
                        CALL SB(HEAD, LINE1, LINE2, LINE3) ! SB# routine
                END IF
        END DO
        RETURN
C
C
C
C       GRID:
C               This makes a time domain file with a harmonic
C           value of 100 at every given number of nanoseconds
C           in the main buffer.
C
C
        ENTRY GRID(HEAD, LINE1, LINE2, LINE3)
        WRITE(IOUT,10)  ! prompt for the number of nanoseconds between lines
        READ(COM_UNIT,20) SEC      ! The number of nanoseconds between lines
        CALL CREATE(HEAD, LINE1, LINE2, LINE3)    ! Create a new time domain
```

```
C file in the main buffer
        TEMP=100.0       ! The amplitude of the line in the time domain file
        INC=SEC*41! The size of the increment (41 harmonics = 1 nanosecond)
        N=INC                            ! The current harmonic to be changed
        WRITE(IOUT,30)                   ! Prompt for the width of the line
        READ(COM_UNIT,*) GWID            ! The width value
        DO WHILE(N .LE. 4096)    ! For all the harmonics in the time domain file:
                DO I=1,GWID         !     The line will have a width of GWID
                        CALL GRD        ! Change the value of these harmonics
                        N=N+1          !Make the line wide enough
                END DO
                N=N-GWID ! Figure out the increment to the next set of harmonics
                N=N+INC
        END DO
10      FORMAT(' How many nanoseconds per division?')
20      FORMAT(F10.2)
30      FORMAT(' How many harmonics wide should the line be?')
        RETURN
C
C
C
C       PROC:
C               This command allows the user to specify a list
C           of files to be processed and how these files are to
C           be processed. This facilitates the processing of
C           of large amounts of data.
C
C
        ENTRY PROC
        PROC_FLAG=.TRUE.                                  ! tell the rest of the
C program that Proc is being used
        WRITE(IOUT,31)                 ! does the user have a def. file already?
        WRITE(IOUT,32)
        READ(COM_UNIT,33) REPLY                                     ! get answer
        IF (REPLY .EQ. 'Y') THEN                                    ! if yes then
                WRITE(IOUT,34)                                   ! ask for filename
                READ(COM_UNIT,33) PROCNAME                     ! read in file name
                GOTO 58
        ELSE
                DEFINE_FLAG=.TRUE.                        ! set definition flag
                WRITE(IOUT,35)                            ! instruction prompt
                WRITE(IOUT,40)
                WRITE(IOUT,45)
                WRITE(IOUT,50)
                WRITE(IOUT,52)
                WRITE(IOUT,53)
                CALL LOGGER             ! make a definition file of the commands
                PROCNAME='USER2:[DURAL.CIMAG2]PROC.DAT'      ! make the
C  definition file
        END IF
31      FORMAT(' Do you have a procedure definition file')
32      FORMAT('    for this process already?(Y or N)')
33      FORMAT( A )
34      FORMAT(' Filename:')
35      FORMAT(' Enter the process using regular commands and')
40      FORMAT('    NAME.DAT for a filename. For the new')
45      FORMAT('    filename use NEWNAME.DAT. When finished')
50      FORMAT('    defining the process use the command DONE.')
52      FORMAT('   (Warning: a filename must be listed for ')
53      FORMAT('                        each time it is used.)')
        RETURN
C
        ENTRY PROC2                          ! reentry after DONE command
        CALL STO_LOG                         ! close up the definition file
        DEFINE_FLAG=.FALSE.                  ! reset definition flag
        WRITE(IOUT,55)                 ! ask whether he wants to save def.
```

```
        READ(COM_UNIT,56) REPLY                                  ! read in answer
        IF(REPLY .EQ. 'Y') THEN                       ! if he wants to save the def
                WRITE(IOUT,57)                        ! prompt for a file name
                READ(COM_UNIT,56) NAME                ! read the filename
                COMMAND(1:33)='$COPY USER2:[DURAL.CIMAG2]PROC.DAT '! the first
C  half of the command
                COMMAND(34:75)=NAME   ! the filename that the copy is output to
                CALL LIB$SPAWN( COMMAND )   ! spawn a process to copy the file
        END IF
55      FORMAT(' Do you wish to save this procedure definition?(Y or N)')
56      FORMAT( A )
57      FORMAT(' Filename:')
C
58      WRITE(IOUT,59)                    ! Ask if there is already a data list
        READ(COM_UNIT,75) REPLY                          ! get answer
        IF(REPLY .EQ. 'Y') THEN
                WRITE(IOUT,60)
                READ(COM_UNIT,75) LISTNAME               ! data list filename
                CALL OPENER(LIST_UNIT,LISTNAME)                    ! get a LU#
                CLOSE(LIST_UNIT)                         ! close the unit back up
        ELSE
                LISTNAME='USER2:[DURAL.CIMAG2]LIST.DAT'
                CALL OPENER(LIST_UNIT,LISTNAME)                    ! open a file
                WRITE(IOUT,61)                                     ! prompt
                WRITE(IOUT,65)
                WRITE(IOUT,70)
                READ(COM_UNIT,75) NAME                 ! read first name in list
                DO WHILE(NAME .NE. 'DONE')                 ! when finished use
C the word DONE
                        WRITE(LIST_UNIT,75) NAM   ! write name into list file
                        READ(COM_UNIT,75) NAME                 ! read next name
                END DO
                CLOSE(LIST_UNIT)                         ! close the list file
                WRITE(IOUT,71)                ! ask the user if it should be saved
                READ(COM_UNIT,75) REPLY
                IF(REPLY .EQ. 'Y') THEN
                        WRITE(IOUT,60)                   !ask for file name
                        COMMAND(1:34)='$COPY USER2:[DURAL.CIMAG2]LIST.DAT '
C the first half of the command
                        COMMAND(35:75)=NAME   ! the filename that the copy
C is output to
                        CALL LIB$SPAWN( COMMAND )        ! spawn a process to
C copy the file
                END IF
        END IF
59      FORMAT(' Do you have a data list file?(Y or N)')
60      FORMAT(' Filename:')
61      FORMAT(' Enter the list of data files, following')
65      FORMAT('   each with <CR>. When finished type the')
70      FORMAT('   word DONE.')
71      FORMAT(' Do you wish to save this data list?(Y or N)')
75      FORMAT( A )
C
C
        WRITE(IOUT,76)                        ! is there an output name file
        READ(COM_UNIT,75) REPLY                          ! read answer
        IF (REPLY .EQ. 'Y') THEN
                WRITE(IOUT,77)                           ! prompt for a filename
                READ(COM_UNIT,75) OUTNAME
                CALL OPENER(NEW_UNIT,OUTNAME)                      ! get a LU#
                CLOSE(NEW_UNIT)
        ELSE
                OUTNAME='USER2:[CIMAG2]NEWLIST.DAT'      ! list of new file names
                CALL OPENER(NEW_UNIT,OUTNAME)            ! open newlist file
                WRITE(IOUT,80)                                     ! prompt
                WRITE(IOUT,85)
```

```
                WRITE(IOUT,90)
                READ(COM_UNIT,95) NAME                       ! initial read
                DO WHILE(NAME .NE. 'DONE')
                        WRITE(NEW_UNIT,95) NAME     ! put the new name in file
                        READ(COM_UNIT,95) NAME           ! read next file name
                END DO
                CLOSE(NEW_UNIT)
                WRITE(IOUT,78)                                       ! save?
                READ(COM_UNIT,75) REPLY
                IF (REPLY .EQ. 'Y') THEN
                        WRITE(IOUT,77)
                        READ(COM_UNIT,75) NAME
                        COMMAND(1:37)='$COPY USER2:[DURAL.CIMAG2]NEWLIST.DAT '
C the first half of the command
                        COMMAND(38:75)=NAME                          ! the filename
C that the copy is output to
                        CALL LIB$SPAWN( COMMAND )        ! spawn a process
C to copy the file
                END IF
        END IF
76      FORMAT(' Is there an output filename list?(Y or N)')
77      FORMAT(' Filename:')
78      FORMAT(' Do you wish to save this list?(Y or N)')
80      FORMAT(' Enter a list of the output file names in')      ! The prompt
85      FORMAT('   the order they are to be used. When')
90      FORMAT('   finished type DONE.')
95      FORMAT( A )
C
C
        WRITE(IOUT,97)
97      FORMAT('  Your data is being processed.')
C
        CALL OPENER(PROC_UNIT,PROCNAME)
        OPEN( UNIT=LIST_UNIT ,
     +          FILE=LISTNAME ,
     +          STATUS='OLD')
        OPEN( UNIT=NEW_UNIT ,
     +          FILE=OUTNAME ,
     +          STATUS='OLD')
        NAME='USER2:[DURAL.CIMAG2]PROC2.DAT'              ! The command procedure
        CALL OPENER(PROC2_UNIT,NAME)
C
C
        READ( LIST_UNIT, 100, IOSTAT=LISTSTAT ) NAME     ! Initial read from
C data file
        DO WHILE(LISTSTAT .NE. FOR_EOF)          ! do while there is still data
C to be processed
                READ( PROC_UNIT , 100 , IOSTAT=PROCSTAT ) OPER  ! initial read
C from definition
                DO WHILE(PROCSTAT .NE. FOR_EOF)          ! do entire definition
                        IF( OPER .EQ. 'NAME.DAT' ) THEN           ! if the data
C file name is needed then get the name
                                IF(LISTSTAT .EQ. FOR_EOF) THEN  ! if there is
C no filename print error
                                        CALL LIB$SIGNAL(MAG_COM)
                                END IF
                                OPER=NAME
                                READ( LIST_UNIT, 100, IOSTAT=LISTSTAT ) NAME
C! read next data entry
                        ELSE IF( OPER .EQ. 'NEWNAME.DAT' ) THEN   ! if output
C file is needed
                                READ( NEW_UNIT, 100 , IOSTAT=NEWSTAT ) NEWNAME
C! read output file name
                                IF(NEWSTAT .EQ. FOR_EOF) THEN   ! if error
C print message
                                        CALL LIB$SIGNAL(MAG_COM)
```

```
                                 END IF
                                 OPER=NEWNAME   ! give command procedure the
C new name
                         END IF
                         WRITE(PROC2_UNIT,100) OPER
                         READ( PROC_UNIT, 100, IOSTAT=PROCSTAT) OPEN  ! read
C next def. statement
                  END DO
                  CLOSE(PROC_UNIT)                       ! start definition over
                  OPEN( UNIT=PROC_UNIT ,                 ! start definition over
     +                  FILE=PROCNAME ,
     +                  STATUS='OLD')
          END DO
100       FORMAT( A )
C
          CLOSE(PROC_UNIT)                               ! close all the files
          CLOSE(LIST_UNIT)
          CLOSE(NEW_UNIT)
          CLOSE(PROC2_UNIT)
C
          CALL LIB$FREE_LUN( PROC_UNIT )                 ! free up the LU#'s
          CALL LIB$FREE_LUN( LIST_UNIT )
          CALL LIB$FREE_LUN( NEW_UNIT )
          CALL LIB$FREE_LUN( PROC2_UNIT )
C
          CALL FILE                             ! execute the command procedure
          RETURN
C
          ENTRY PROC3
          IF (PROCNAME .EQ. 'USER2:[DURAL.CIMAG2]PROC.DAT') THEN  ! delete all
C the utility files
                  OPEN(UNIT=1,FILE='PROC.DAT',TYPE='OLD',
     +                    DEFAULTFILE='USER2:[DURAL.CIMAG2]',DISP='DELETE')
                  CLOSE(UNIT=1)
          END IF
          IF (LISTNAME .EQ. 'USER2:[DURAL.CIMAG2]LIST.DAT') THEN
                  OPEN(UNIT=1,FILE='LIST.DAT',TYPE='OLD',
     +                    DEFAULTFILE='USER2:[DURAL.CIMAG2]',DISP='DELETE')
                  CLOSE(UNIT=1)
          END IF
          IF (OUTNAME .EQ. 'USER2:[DURAL.CIMAG2]NEWLIST.DAT') THEN
                  OPEN(UNIT=1,FILE='NEWLIST.DAT',TYPE='OLD',
     +                    DEFAULTFILE='USER2:[DURAL.CIMAG2]',DISP='DELETE')
                  CLOSE(UNIT=1)
          END IF
          OPEN(UNIT=1,FILE='PROC2.DAT',TYPE='OLD',
     +            DEFAULTFILE='USER2:[DURAL.CIMAG2]',DISP='DELETE')
          CLOSE(UNIT=1)
C
          PROC_FLAG=.FALSE.                                      ! turn off flag
C
          RETURN
C
C
          END
C
C
          SUBROUTINE OPENER(L_UNIT,NAME)
C
C                 This routine opens up a file and gets a LU#
C
C
          INTEGER*4 FOR_RETCODE                          ! fortran return code
          INTEGER*4 RETCODE                   ! return code for system operations
          INTEGER*4 SS$_NORMAL                                   ! normal return
C
```

```
        INTEGER*4 L_UNIT                                         ! logical unit #
C
        CHARACTER*70 NAME                                        ! file name
C
        PARAMETER (SS$_NORMAL = '00000001'X)             ! normal return code
C
C
        RETRCODE=LIB$GET_LUN( L_UNIT )             ! get the LU# for the list file
        IF (RETCODE .EQ. SS$_NORMAL) THEN                ! if no errors occurred
                OPEN(   UNIT=L_UNIT ,                    ! open the list file
     +                  FILE=NAME ,
     +                  STATUS='UNKNOWN')
C
C
        ELSE
                WRITE(IOUT,55)                           ! error conditions
                CALL LIB$STOP(%VAL(RETCODE))
        END IF
C
55      FORMAT(1X,'ERROR IN RETRIEVING LU#')
        RETURN
        END
C
C
C       SUBROUTINE OUTSIDER:
C               These are routines are more basic commands
C          such as those found in COM_FILE.
C
C
C
        SUBROUTINE OUTSIDER
C
        INCLUDE 'USER2:[DURAL.CIMAG2]FTRN.FOR'
        INCLUDE 'USER2:[DURAL.CIMAG2]MAGCMN.FOR'
        INCLUDE 'USER2:[DURAL.CIMAG2]MAGCMN2.FOR'
        INCLUDE 'USER2:[DURAL.CIMAG2]HEADER.CMN'
C
C
C       CREATE:
C               Creates a blank time domain file with a
C           header and stores it in the main buffer.
C
C
        ENTRY CREATE(HEAD, LINE1, LINE2, LINE3)
C
        WRITE(IOUT,*) 'Type in the header:(three lines)'        ! prompt
        READ(COM_UNIT,10) LINE1                                  ! read in
C the new header
        READ(COM_UNIT,10) LINE2
        READ(COM_UNIT,10) LINE3
10      FORMAT(60A1)
C
        DO I=1,ISIZE
                P(I,1)=0                        ! The original array is '0's
        END DO
        IDS(1)=0
        DOMAIN='TIME'                   ! This file is in the time domain
        RETURN
C
C
C
C
C       CHANGE:
C               This routine changes a given harmonic in a data
```

```
C          file.
C
C
       ENTRY CHANGE
       WRITE(IOUT,30)                  ! Prompt for the harmonic to be changed
       READ(COM_UNIT,*) N              ! Read in the value for the harmonic
       WRITE(IOUT,40) (N,P(N,1))       ! Give the current value of the harmonic
       WRITE(IOUT,50)                          ! Prompt for the new value
       READ(COM_UNIT,60) TEMP                          ! The new value
       ENTRY GRD
       P(N,1)=TEMP               ! Put the new value in the specified harmonic
30     FORMAT(X,'Which harmonic do you wish to change?')
40     FORMAT(' Current Value: ',I5,F10.2)
50     FORMAT(' New Value: ')
60     FORMAT(F10.2)
       RETURN
       END
C
C
C******************************************************************
C*****************************************************************
C      FTRAN READ COMMANDS (BY A. DOMINEK)
C******************************************************************
C      THE CALLING PROGRAM MUST CONTAIN THE FOLLOWING
C      COMMON BUFFER,NDIM,ANST,AINC
C      DIMENSION AMPL(5000),PHS(5000)
C      BYTE BUFFER(35000)
C      INTEGER*2 INPFILE(15)
C      USER SUPPLIES THE FILE NAME IN VARIABLE 'INPFILE'
C      IN FREQUENCY DOMAIN
C            AMPL   CONTAINS AMPLITUDE OF DATA IN DB
C            PHS   CONTAINS PHASE OF DATA IN DEGREES
C            NDIM IS THE NUMBER OF FREQUENCY SAMPLES
C            ANST IS THE FREQUENCY (MHZ) OF THE FIRST SAMPLE
C            AINC IS THE DELTA FREQUENCY (MHZ)
C      IN TIME DOMAIN
C            AMPL   CONTAINS THE AMPLITUDE OF TIME WAVEFORM
C            PHS   CONTAINS ZERO
C            NDIM IS THE NUMBER OF TIME SAMPLES = 4096
C            ANST IS THE STARTING TIME =1/DF/2 (DF=DELTA FREQUENCY)
C            AINC IS THE DELTA TIME * 1.E5  =1/DF/4096*1.E5

CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC

       SUBROUTINE FREA(INPFILE,AMPL,PHS)
C
C
C      PROGRAM NAME :USER1:[DOMI]REAV.FOR
C      THIS PROGRAM READS BACKSCATTER DATA FILES STORED
C      ON VAX DISKS. WITH 11/23 FORMAT
C
C
       INCLUDE'USER2:[DURAL.CIMAG2]MAGCMN.FOR'
       INCLUDE 'USER2:[DURAL.CIMAG2]MAGCMN2.FOR'
       INCLUDE 'USER2:[DURAL.CIMAG2]FTRN.FOR'
C
       INTEGER*2 LIN1(30),LIN2(30),PARAM(30)
       REAL*4 AP(10000)

C
C      DEFINE BUFFER STRUCTURE
C
       EQUIVALENCE(LIN1(1),BUFFER(1)),(LIN2(1),BUFFER(61))
     1,(PARAM(1),BUFFER(121)),(AP(1),BUFFER(361))
       EQUIVALENCE(LINE1(1),LIN1(1)),(LINE2(1),LIN2(1))
     1,(LINE3(1),PARAM(1))
```

```
C
C
C       READ A FILE
C
        CALL TTR(INPFILE)
        TYPE 105,LIN1
        TYPE 105,LIN2
        TYPE 105,PARAM
105     FORMAT(X,30A2)
C
C
C       GET NUMERICAL INFORMATION FROM THE THIRD LINE
C       OF THE HEADER
C
        CALL DDCDE
C
C
C       DIVIDE AN AMP-PHASE ARRAY INTO
C       AN AMP ARRAY AND A PHASE ARRAY
C
        DO 199 NN=1,NDIM
        AMPL(NN)=AP(2*NN-1)
C       IF(AMPL(NN).GT.35)AMPL(NN)=35.
199     PHS(NN)=AP(2*NN)
C
C       CARY INFORMATION TO 'CIMAG' (TIME DOMAIN ONLY)
        DO 1 I=1,NDIM
1       P(I,1)=AMPL(I)
C
C       CHECK FOR BAD DATA POINTS, I.E., AMPL(I).GT.995
C
        CALL ERRF(AMPL,PHS)
        RETURN
        END
C ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
        SUBROUTINE REU(INPFILE,AMPL,PHS)
C       THIS PROGRAM READS BACKSCATTER DATA FILES STORED
C       ON VAX DISKS. WITH 750 FORMAT
C
C
        INCLUDE'USER2:[DURAL.CIMAG2]MAGCMN.FOR'
        INCLUDE 'USER2:[DURAL.CIMAG2]MAGCMN2.FOR'
        INCLUDE 'USER2:[DURAL.CIMAG2]FTRN.FOR'
C
        BYTE PARAM(60)
        INTEGER*2 L1(30),L2(30),L3(30)
        REAL*4 AP(10000)
        EQUIVALENCE (L3(1),PARAM(1))
        EQUIVALENCE(L1(1),BUFFER(1)),(L2(1),BUFFER(61))
     1,(L3(1),BUFFER(121)),(AP(1),BUFFER(361))
1       WRITE(IOUT,2)
2       FORMAT('$','ENTER DATA FILE NAME: ')
        READ(COM_UNIT,10) INPFILE
10      FORMAT(15A2)
        WRITE(LOG_UNIT,10)INPFILE
        INPFILE(15)=0
        OPEN(UNIT=8,NAME=INPFILE,TYPE='OLD',FORM='UNFORMATTED',
     1READONLY,ERR=1)
        READ(8) L1
        READ(8) L2
        READ(8) L3
        TYPE 100,L1
        TYPE 100,L2
        TYPE 100,L3
100     FORMAT(X,30A2)
```

```
      DECODE(4,4,PARAM(3),ERR=1001)NDIM
      DECODE(5,5,PARAM(11),ERR=1002)IANST
      ANST=FLOAT(IANST)
      DECODE(5,5,PARAM(20),ERR=1003)IAINC
      AINC=FLOAT(IAINC)
4     FORMAT(I4)
5     FORMAT(I5)
      DO 200 I=1,NDIM
      READ(8) AMPL(I),PHS(I)
      IO=2*I-1
      IE=2*I
      AP(IO)=AMPL(I)
200   AP(IE)=PHS(I)
      CLOSE (UNIT=8,DISP='SAVE')
      CALL ERRF(AMPL,PHS,NDIM)
      GO TO 99
1001  WRITE(IOUT,*) '  DECODE ERROR  NDIM'
      GO TO 99
1002  WRITE(IOUT,*) '  DECODE ERROR  ANST'
      GO TO 99
1003  WRITE(IOUT,*) '  DECODE ERROR  AINC'
99    RETURN
      END
C^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
      SUBROUTINE TTR(INPFILE)
      BYTE TBUFF(512)
      INCLUDE 'SYS$LIBRARY:FORIOSDEF'
      INCLUDE'USER2:[DURAL.CIMAG2]MAGCMN.FOR'
      INCLUDE 'USER2:[DURAL.CIMAG2]MAGCMN2.FOR'
      INCLUDE 'USER2:[DURAL.CIMAG2]FTRN.FOR'
C
C
      WRITE(IOUT,1111)
1111  FORMAT(1X,' ENTER DATA FILE NAME:')
6     READ(COM_UNIT,2222) INPFILE
2222  FORMAT(15A2)
      WRITE(LOG_UNIT,2222) INPFILE
      INPFILE(15)=0
      IB=1
      ICNT=0
8106  OPEN(UNIT=8,NAME=INPFILE,READONLY,TYPE='OLD',IOSTAT=IERR,ERR=8100)
C
C     SET BLOCK LENGTH IN BYTES
C
82    IF(IB.EQ.1)LEN=512-9*4
      IF(IB.GT.1)LEN=512-26*4
C
C     READ A BLOCK OF 512 BYTES
C
      READ(8,80,END=90) TBUFF
80    FORMAT(512A1)
C
C     STORE A BLOCK INTO THE BUFFER ACCORDING TO ITS LENGTH
C
      DO 85 I=1,LEN
85    BUFFER(ICNT+I)=TBUFF(I)
      IB=IB+1
      ICNT=ICNT+LEN
      GO TO 82
90    DO 86 I=1,LEN
86    BUFFER(ICNT+I)=TBUFF(I)
C
C     ELIMINATE BLANK SPACES IN BETWEEN EACH CHARACTER
C     IN A FILE HEADER
C
```

```
      DO 40 I=1,180
40    BUFFER(I)=BUFFER(2*I-1)
      GO TO 331
8100  IF(IERR.EQ.FOR$IOS_FILNOTFOU)THEN
      WRITE(IOUT,1112) INPFILE
1112  FORMAT(' FILE ',15A2,'WAS NOT FOUND',/,'$',
     1 'ENTER FILENAME AGAIN: ')
      ELSE IF (IERR.EQ.FOR$IOS_FILNAMSPE)THEN
      WRITE(6,1113) INPFILE
1113  FORMAT('$','FILE : ',15A2,' WAS BAD, ENTER NEW FILENAME: ')
      ELSE
      TYPE *,'UNRECOVERABLE ERROR, CODE=',IERR
      STOP
      ENDIF
      GO TO 6
331   CLOSE(UNIT=8,DISP='SAVE')
      RETURN
      END

C ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^

      SUBROUTINE DDCDE
      INTEGER*4 IMIN,IINC,NDIM
      INCLUDE'USER2:[DURAL.CIMAG2]MAGCMN.FOR'
      INCLUDE 'USER2:[DURAL.CIMAG2]MAGCMN2.FOR'
      INCLUDE 'USER2:[DURAL.CIMAG2]FTRN.FOR'
C
C     NO OF DATA POINTS IS STORED IN FOUR CHARACTERS, AND
C     STARTING ANGLE AND ANGLE INC. IN 5 CHARACTERS
C
      CHARACTER*3 CNL1
      CHARACTER*4 CNL
      CHARACTER*5 CFF,CINC
      CHARACTER*1 ECH,TCAS
      DATA ECH,ZERO/'=','0'/
      EQUIVALENCE (BUFFER(123),CNL),(BUFFER(131),CFF),(BUFFER(140),CINC)
      EQUIVALENCE (BUFFER(123),TCAS),(BUFFER(124),CNL1)
C
C
C     CONVERT CHARACTERS INTO THEIR NUMERICAL EQUIVALENTS
C
      IF(ECH.EQ.TCAS) THEN
      DECODE(3,102,CNL1,ERR=9)NDIM
      ELSE
      DECODE(4,101,CNL,ERR=9)NDIM
      END IF
100   FORMAT(I5)
101   FORMAT(I4)
102   FORMAT(I3)
103   DECODE(5,100,CFF,ERR=99)IMIN
104   DECODE(5,100,CINC,ERR=999)IINC
      ANST=FLOAT(IMIN)
      AINC=FLOAT(IINC)
      RETURN
C
9     WRITE (6,200) 'NDIM'
      READ (5,*,ERR=91) NDIM
      GO TO 103
C
99    WRITE (6,200,ERR=991) 'ANST'
      READ(5,*) ANST
      GO TO 104
C
999   WRITE (6,200,ERR=9991) 'AINC'
      READ(5,*) AINC
      RETURN
```

```
C
200     FORMAT (/,'$','HAVING PROBLEMS READING HEADER. ENTER ',A4,
     1' MANUALLY: ')
C
91      WRITE(6,300)
        GO TO 9
C
991     WRITE(6,300)
        GO TO 99
C
9991    WRITE(6,300)
        GO TO 999
C
300     FORMAT(1X,'***INVALID ENTRY***')
C
        END
C ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
        SUBROUTINE ERRF(AMPL,PHS)
        COMPLEX C1,C2,CD
        INCLUDE'USER2:[DURAL.CIMAG2]MAGCMN.FOR'
        INCLUDE 'USER2:[DURAL.CIMAG2]MAGCMN2.FOR'
        INCLUDE 'USER2:[DURAL.CIMAG2]FTRN.FOR'
        DO 1 I=1,NDIM
        IF(PHS(I).GT.995.) WRITE(6,2) I,AMPL(I),PHS(I)
1       CONTINUE
2       FORMAT(1X,16HERROR AT DATA PT,1I4,4HMAG=,1F10.4,4HPHS=,1F10.4)
C       CHECK LEFT HAND END POINT
        IF(AMPL(1).GT.100.) THEN
         DO 200 I=2,NDIM
         IF(AMPL(I).LE.100. .AND. AMPL(I+1).LE.100.) THEN
          A1=10.**(AMPL(I)/20.)
          C1=CMPLX(A1*COSD(PHS(I)),A1*SIND(PHS(I)))
          A2=10.**(AMPL(I+1)/20.)
          C2=CMPLX(A2*COSD(PHS(I+1)),A2*SIND(PHS(I+1)))
          CD=C1-C2
          RD=REAL(CD)
          AD=AIMAG(CD)
          DO 212 II=1,I-1
          RC=REAL(C1)+RD*II
          AC=AIMAG(C1)+AD*II
          AMPL(II)=20.*LOG10(SQRT(RC*RC+AC*AC))
          PHS(II)=ATAN2D(AC,RC)
212       CONTINUE
          GO TO 211
          ELSE
          END IF
200      CONTINUE
         ELSE
         END IF
C       CHECK RIGHT HAND END POINT
211     IF(AMPL(NDIM).GT.100.) THEN
         DO 220 I=1,NDIM
         J=NDIM-I
         IF(AMPL(J).LE.100. .AND. AMPL(J-1).LE.100.) THEN
          A1=10.**(AMPL(J)/20.)
          C1=CMPLX(A1*COSD(PHS(J)),A1*SIND(PHS(J)))
          A2=10.**(AMPL(J-1)/20.)
          C2=CMPLX(A2*COSD(PHS(J-1)),A2*SIND(PHS(J-1)))
          CD=C1-C2
          RD=REAL(CD)
          AD=AIMAG(CD)
          DO 222 II=J+1,NDIM
          RC=REAL(C1)+RD*(II-J)
          AC=AIMAG(C1)+AD*(II-J)
          AMPL(II)=20.*LOG10(SQRT(RC*RC+AC*AC))
          PHS(II)=ATAN2D(AC,RC)
```

```
222       CONTINUE
          GO TO 221
          ELSE
          END IF
220      CONTINUE
         ELSE
         END IF
C       CHECK INTERIOR POINTS
221     DO 230 I=2,NDIM-1
        IF(AMPL(I).GT.100.) THEN
         DO 240 K=I+1,NDIM
         IF(AMPL(K).LE.100.) THEN
          A1=10.**(AMPL(I-1)/20.)
          C1=CMPLX(A1*COSD(PHS(I-1)),A1*SIND(PHS(I-1)))
          A2=10.**(AMPL(K)/20.)
          C2=CMPLX(A2*COSD(PHS(K)),A2*SIND(PHS(K)))
          CD=(C1-C2)/(K-I+1)
          RD=REAL(CD)
          AD=AIMAG(CD)
          DO 241 II=I,K-1
          RC=REAL(C1)+RD*(II-I+1)
          AC=AIMAG(C1)+AD*(II-I+1)
          AMPL(II)=20.*LOG10(SQRT(RC*RC+AC*AC))
          PHS(II)=ATAN2D(AC,RC)
241       CONTINUE
          GO TO 230
          ELSE
          END IF
240      CONTINUE
         ELSE
         END IF
230      CONTINUE
        RETURN
        END
```

```
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
CC
CC        MAGCMN.FOR
CC        PROGRAM COMMON BLOCKS
CC
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
        INTEGER*2       HEAD(256,31),LINE1(30),LINE2(30),LINE3(30)
        INTEGER*2       BUFFERS(400,30)
        INTEGER*4       NB, ISIZE
        INTEGER*4       PNUM,ELEMENT,ELEM
        REAL            VALUE,PVALUE,WEIGHT
        LOGICAL         EFLAG                                    !error flag
        LOGICAL         ECHO
        CHARACTER*4     DOMAIN, DOM(40)
        CHARACTER*50    INAME,JNAME,FILNM
        CHARACTER*60    TITLE,XLAB,YLAB
        CHARACTER*40    FNAME
        DIMENSION       P(4096,31),IDS(31),S(1024),Q(4096),ARRAY(3,100,100)
        DIMENSION       NUMB(3),ANG(3,400),BUFN(3,400),CNTR(3,400)
        DIMENSION       CARRAY(4,8),CLRTAB(6),ARRAY2(3,100,100)
        COMPLEX A(4096),CCI,CCX,BCX,DCX
        COMPLEX BA(201),KLA,CA(2049),ASQ,ASS1,ASS2,ASD1,ASC,ASD,ASA,ASB
        CHARACTER*20 INFILE
        REAL FA(2049)
        BYTE MACRO(128)
        INTEGER*2 BFILE(6)
C
C
C
C
        COMMON/BLK1/INAME, JNAME,                     ! The main common block
     +          FILNM, TITLE, XLAB, YLAB, P, IDS, S, Q,
     +          ARRAY, NUMB, ANG, BUFN, CNTR, CARRAY, CLRTAB,
     +          A, CCI, CCX, BCX, DCX, BA, KLA, CA, ASQ, ASS1,
     +          ASS2, ASD1, ASC, ASD, ASA, ASB, INFILE, FA,
     +          MACRO, BFILE, BUFFERS, DOMAIN, DOM, NB, ECHO,
     +          ARRAY2, ISIZE,FNAME
C
```

```
cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc
cc
cc                    MAGCMN2.FOR
cc       THIS IS THE PROGRAM CONTROLS COMMON BLOCK
cc
cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc
c
c
        INTEGER*4
     +          COM_UNIT ,              ! LU# for the command input
     +          IOUT ,                  ! LU# for the program output
     +          TERM_UNIT ,             ! LU# for the terminal
     +          FILE_UNIT ,             ! LU# for the command file
     +          LOG_UNIT ,              ! LU# for the log file
     +          NULL_UNIT,              ! LU# of null device for logging routine
     +          STO_UNIT                ! LU# for buffer storage
c
c
        CHARACTER*40    DEF             ! default directory
        LOGICAL         PROC_FLAG
        LOGICAL         DEFINE_FLAG
c
        COMMON/BLK2/COM_UNIT, IOUT, TERM_UNIT, FILE_UNIT,
     +          DEF, LOG_UNIT, NULL_UNIT, PROC_FLAG,
     +          DEFINE_FLAG
```

```
cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc
CC                FTRN.FOR
cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc
C
C
      COMMON BUFFER,NDIM,ANST,AINC,FTYPE
      DIMENSION AMPL(5000),PHS(5000)
      BYTE BUFFER(35000)
      INTEGER*2 INPFILE(15)
      LOGICAL FTYPE
```

```
CCCCCCCCaCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
CC
CC
CC      DEFINE THE TAPE HEADER FIELDS
CC
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
CC
CC
        BYTE       ITITLE(50)     !TITLE
        INTEGER*2 IHED(6)         !DATE AND TIME AS MONTH,DAY,YEAR
C                                 ! HOURS,MINUTES,SECONDS
        BYTE       ITARG(38)      !TARGET LABEL
        INTEGER*2 IANG(3)         !STARTING ANGLE, ANGLE INCREMENT FOR ROTATION
C                                 ! AND NUMBER OF ANGLES IN WHOLE FILE
        BYTE       ITYPE(6)       !ACOUSTIC DATA TYPE PCW,PLFM
        INTEGER*2 IPARAM(6)       !FREQUENCY IN KHZ, SAMPLE INTERVAL, INTERVAL
C                                 ! UNITS, AND NUMBER OF PINGS AT A GIVEN ANGLE
        INTEGER*2 IDEANG          !ELEVATION/DECLINATION ANGLE
        INTEGER*2 IPULTH          !PULSE LENGTH - DIGITS ONLY
        INTEGER*2 IPUNIT          !UNITS FOR PULSE LENGTH
        INTEGER*2 IMODFW          !MODULATION BANDWIDTH FOR PLFM
        INTEGER*2 ISTRNG          !SOURCE-TARGET RANGE IN METERS * 100
        INTEGER*2 ISRRNG          !SOURCE-RECEIVER RANGE IN METERS * 100
        INTEGER*2 IXMTVL          !RMS TRANSMIT VOLTAGE * 100
        INTEGER*2 IRCVGN          !RECEIVER GAIN IN DB * 10
        INTEGER*2 IFTRBW          !RECEIVE FILTER 3-DB BW IN KHZ
        BYTE       IPROJ(20)      !PROJECTOR DESCRIPTION
        INTEGER*2 ITRV            !XMIT LEVEL OF PROJECTOR IN DB/MICRO PA/V*10
        BYTE       IHYD(20)       !RECEIVER DESCRIPTION
        INTEGER*2 IRRS            !RECEIVER SENSITIVITY IN DB/V/MICRO PA*10
        INTEGER*2 IDATR           !NUMBER OF BIOMATION SAMPLES IN A SINGLE PING
C
C
C
        INTEGER*2 HEADER(256)
        COMMON /HEADER/ ITITLE,IHED,ITARG,IANG,ITYPE,IPARAM,IDEANG,IPULTH,
       2                IPUNIT,IMODFW,ISTRNG,ISRRNG,IXMTVL,IRCVGN,IFTRBW,
       3                IPROJ,ITRV,IHYD,IRRS,IDATR,IOTHER
        EQUIVALENCE (HEADER,ITITLE)
```

APPENDIX C

CIMAG2 LINKING SUBROUTINES

```
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
CC
CC                INTER
CC        FREQUENCY DOMAIN READ
CC
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
CC
        SUBROUTINE FRD1(P,EFLAG)
        LOGICAL EFLAG                                              ! error flag
        INTEGER*2 HEAD(256)
        REAL P(4096,7),AM(2049),PH(2049),FA(2049)
        INCLUDE 'USER2:[DURAL.CIMAG2]MAGCMN2.FOR' ! program control common block
        COMMON/HEADER/HEAD
        ISIZE=4096
        IS2=ISIZE/2.
        TYPE *,' FREQUENCY SAMPLING(1) OR .1KL SAMPLING(0)?'
        READ (COM_UNIT,*) IFS
        WRITE (LOG_UNIT,*) IFS                                     ! log the input
        IF (IFS.EQ.0)TYPE *,'INPUT MAJOR AXIS DIMENSION IN INCHES'
        IF (IFS.EQ.1)TYPE *,'FREQUENCY INCREMENT IN MHZ '
        READ (COM_UNIT,*) DLE
        WRITE (LOG_UNIT,*) DLE                                     ! log the input
        PI=4.*ATAN(1.)
        IF (IFS.EQ.1)DLE=590.551/(PI*DLE)
        TYPE *,' SELECT THE TYPE OF INTERPOLATION'
        TYPE *,'INPUT 0 --> TWO-POINT INTERPOLATION ; NO SMOOTHING'
        TYPE *,'INPUT 1 --> INTERPOLATION AND SMOOTHING USING A COSINE WINDOW'
        READ (COM_UNIT,*) IS
        WRITE (LOG_UNIT,*) IS                                      ! log the input
        TYPE *,' ASSUMED INPUT AMPLITUDE IS IN DB/SQUARE CM '
        TYPE *,' NORMALIZE TO: SQ CM(1),SQ M(2),PI*L*L/4(0)?'
        READ (COM_UNIT,*) INORM
        WRITE (LOG_UNIT,*) INORM                                   ! log the input
        IF (INORM.GT.2.OR.INORM.LT.0) GO TO 5
        DLE=DLE*2.54/100.
        CALL RDFLE(AM,PH,NP,FLOW,FHIGH,FINC,COM_UNIT,EFLAG)
        IF (EFLAG) THEN                                   ! if an error occurred
            RETURN
        END IF
        TWOPI=8.*ATAN(1.)
        RLOW=TWOPI*FLOW*DLE/300.
        RHIGH=TWOPI*FHIGH*DLE/300.
        RINC=.1
        WD=TWOPI*FINC*DLE/300.*6.
        DO 5 I=1,IS2
        P(I+IS2,1)=0
5       P(I,1)=-1024.
        DO 10 I=1,NP
10      FA(I)=(FLOW+(I-1)*FINC)*TWOPI*DLE/300.
        CALL GP(INORM,IS,AM,PH,FA,NP,WD,DLE,RLOW,RHIGH,RINC,P)
        RETURN
        END
C
C
        SUBROUTINE GP(INORM,IS,AM,PH,FA,NP,WD,DLE,RLOW,RHIGH,RINC,P)
        REAL*4 FA(2049),P(4096,7),AM(2049),PH(2049)
        COMPLEX*8 R,CA(2049)
        PI=4.*ATAN(1.)
        DO 111 I=1,NP
        ATMP=10.**(AM(I)/20.)
        PTMP=PH(I)/180.*PI
111     CA(I)=CMPLX(ATMP*COS(PTMP),ATMP*SIN(PTMP))
        TWOPI=PI*2.
        I=1
        DO 7720 RF=RLOW,RHIGH,RINC
7740    IF(RF.GE.FA(I).AND.RF.LE.FA(I+1))GO TO 7730
```

```
      I=I+1
      IF(I.GT.NP)GO TO 4912
      GO TO 7740
7730  K=RF*10
      IF(K.GT.2048)GO TO 4912
      IF(IS.EQ.1)CALL INTER(R,CA,FA,NP,NS,I,WD,RF)
      IF(IS.EQ.0)R=(CA(I+1)-CA(I))/(FA(I+1)-FA(I))*(RF-FA(I))+CA(I)
      IF (INORM.EQ.0)R=R*0.02/(SQRT(PI)*DLE)
      IF (INORM.EQ.2)R=R/100.
      P(K,1)=10.24*(10.+20.*ALOG10(CABS(R)))
      P(K+2048,1)=1024.*ATAN2(AIMAG(R),REAL(R))/TWOPI
7720  CONTINUE
4912  RETURN
      END
C
C
      SUBROUTINE INTER(R,CA,FA,ICNT,NS,I,WD,RF)
      COMPLEX*8 R,CA(2049)
      REAL*4 FA(2049)
      WEI=0
      IS=I
      XTMP=0.
      YTMP=0.
      RFL=RF-WD/2.
      RFH=RF+WD/2.
20    IF(IS.GT.ICNT)GO TO 10
      IF(FA(IS).GT.RFH)GO TO 10
      T=FA(IS)-RF
      HAMM=.54+.46*COS(3.1415926*T/WD)
      XTMP=XTMP+HAMM*REAL(CA(IS))
      YTMP=YTMP+HAMM*AIMAG(CA(IS))
      WEI=WEI+HAMM
      IS=IS+1
      GO TO 20
10    IS=I-1
15    IF(IS.LT.1)GO TO 30
      IF(FA(IS).LT.RFL)GO TO 30
      T=FA(IS)-RF
      HAMM=.54+.46*COS(3.1415926*T/WD)
      XTMP=XTMP+HAMM*REAL(CA(IS))
      YTMP=YTMP+HAMM*AIMAG(CA(IS))
      WEI=WEI+HAMM
      IS=IS-1
      GO TO 15
30    R=CMPLX(XTMP/WEI,YTMP/WEI)
      RETURN
      END
C
C
      SUBROUTINE PHCR(DPH,FB,FINC,PH)
      REAL*4 PH(201)
      PI=3.1415926
30    IF(DPH.LT.PI)GO TO 20
      DPH=DPH-PI
      GO TO 30
20    IF(DPH.GT.-PI)GO TO 40
      DPH=DPH+PI
      GO TO 20
40    DO 10 I=1,201
      FA=FB+(I-1)*FINC
10    PH(I)=PH(I)-(DPH*FA/FB)
      RETURN
      END
C
C
      SUBROUTINE EPH(PHM,PH,NS,NF,NI)
```

```
      REAL*4 PH(201)
      WEI=0
      PHM=0
      WD=2.*(NF-NS)
      DO 10 I=NS,NF,NI
      HAMM=.54+.46*COS(3.1415926*(I-NS)/WD)
      WEI=WEI+HAMM
10    PHM=PHM+HAMM*PH(I)
      PHM=PHM/WEI
      RETURN
      END
```

```
cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc
cc
cc                  RDFLE
cc          FREQUENCY DOMAIN READ
cc
cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc
cc
cc
        SUBROUTINE RDFLE(A,P,NP,FMIN,FMAX,FINC,COM_UNIT,EFLAG)
        CHARACTER*1 YN
        LOGICAL EFLAG
        COMMON BUFF
        BYTE BUFF(20000)
        INTEGER*2 LINE1(30),LINE2(30),PARAM(30),OFILE(15)
        INTEGER*4 COM_UNIT
        CHARACTER*70 INFILE
        REAL*4 AP(4098),A(2049),P(2049)
        INTEGER*2 HEADR(256)
        COMMON/HEADER/HEADR
C
C       DEFINE BUFFER STRUCTURE
C
        EQUIVALENCE(LINE1(1),BUFF(1)),(LINE2(1),BUFF(61))
     1,(PARAM(1),BUFF(121)),(AP(1),BUFF(361))
        CALL TR(INFILE,IB,EFLAG)
        IF ( EFLAG ) THEN                              ! if error has occurred
                RETURN                                 ! then return
        END IF
        TYPE 105,LINE1
        TYPE 105,LINE2
        TYPE 105,PARAM
105     FORMAT(X,30A2)
C
C
C
C       PUT INFO IN HEADR BLOCK FOR TRANSFER TO CALLING PROG
C
C
        DO 108 I=1,30
        HEADR(I)=LINE1(I)
        HEADR(30+I)=LINE2(I)
108     HEADR(60+I)=PARAM(I)
C
C
C
C       GET NUMERICAL INFORMATION FROM THE THIRD LINE
C       OF THE HEADER
C
        CALL DCDE(NP,FMIN,FINC,EFLAG)
        IF (EFLAG) THEN                                ! if error return
                RETURN
        END IF
C
C       DIVIDE AN AMP-PHASE ARRAY INTO
C       AN AMP ARRAY AND A PHASE ARRAY
C
        DO 199 NN=1,NP
        A(NN)=AP(2*NN-1)
199     P(NN)=AP(2*NN)
688     FORMAT(A1)
689     FORMAT(1X,5(2F12.3,1H;))
        FMAX=FMIN+(NP-1)*FINC
        RETURN
        END
C
C
```

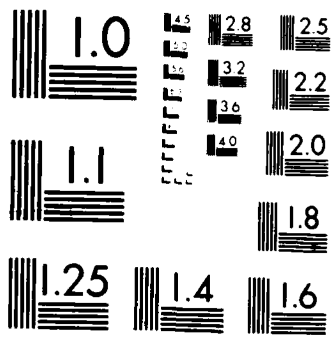
```
      SUBROUTINE TR(INFILE,IB,EFLAG)
      INCLUDE 'MAGCMN2.FOR'
      LOGICAL EFLAG                                        ! error flag
      INTEGER*2 IBUFF(10000)
      CHARACTER*70 INFILE
      INTEGER*4 FOR_RETCODE                         ! fortran return code
      INCLUDE 'USER2:[DURAL.CIMAG2]MSGBLK.FOR'    ! error message declarations
      COMMON BUFF
      BYTE BUFF(20000),TBUFF(1500)
      EQUIVALENCE (BUFF(1),IBUFF(1))
      INCLUDE 'SYS$LIBRARY:FORIOSDEF'
      WRITE(6,5)
5     FORMAT(1X,'TYPE DATA FILE NAME')
      READ (COM_UNIT,10) INFILE
      WRITE (LOG_UNIT,10) INFILE
      IF ((INFILE .EQ. 'NAME.DAT') .AND. DEFINE_FLAG) THEN    ! if defining
C                                                           a procedure then
            INFILE='USER2:[DURAL.CIMAG2]NAME.DAT'    !    use the dummy file
      END IF
10    FORMAT( A )
      IB=1
      ICNT=0
8106  OPEN(UNIT=8,NAME=INFILE,TYPE='OLD',READONLY,IOSTAT=FOR_RETCODE,
     +      DEFAULTFILE=DEF,ERR=81)
      GOTO 82
81    IF (FOR_RETCODE .EQ. 29) THEN                 ! if file is not found
            CALL LIB$SIGNAL(MAG_FILNOTFOU)  ! write out file not found error
            EFLAG = .TRUE.                          ! error flag
            RETURN
      ELSE
            CALL LIB$SIGNAL(MAG_COM)                ! else command error
            EFLAG = .TRUE.                          ! flag the error
            RETURN
      END IF
C
C     SET BLOCK LENGTH IN BYTES
C
82    IF(IB.EQ.1)LEN=512-9*4
      IF(IB.GT.1)LEN=512-26*4
C
C     READ A BLOCK OF 512 BYTES
C
      READ(8,80,END=90)(TBUFF(I),I=1,512)
80    FORMAT(512A1)
C
C     STORE A BLOCK INTO THE BUFFER ACCORDING TO ITS LENGTH
C
      DO 85 I=1,LEN
85    BUFF(ICNT+I)=TBUFF(I)
      IB=IB+1
      ICNT=ICNT+LEN
      GO TO 82
90    DO 86 I=1,LEN
86    BUFF(ICNT+I)=TBUFF(I)
C
C     ELIMINATE BLANK SPACES IN BETWEEN EACH CHARACTER
C     IN A FILE HEADER
C
      DO 40 I=1,180
40    BUFF(I)=BUFF(2*I-1)
331   CLOSE(UNIT=8,DISP='SAVE')
      RETURN
      END
C
C
      SUBROUTINE DCDE(NP,FMIN,FINC,EFLAG)
```

```
      COMMON BUFF
      BYTE BUFF(20000)
      INTEGER*4 IMIN,IINC,NP
C
C     NO OF DATA POINTS IS STORED IN THREE CHARACTERS, AND
C     STARTING FREQ AND FREQ INC. IN 5 CHARACTERS
C
      CHARACTER*4 CNL
      CHARACTER*5 CFF,CINC
      INTEGER*4 FOR_RETCODE                       ! fortran return code
      LOGICAL EFLAG
      INCLUDE 'USER2:[DURAL.CIMAG2]MSGBLK.FOR'    ! error messages
C
      EQUIVALENCE (BUFF(123),CNL),(BUFF(131),CFF),(BUFF(140),CINC)
C
C
C     CONVERT CHARACTERS INTO THEIR NUMERICAL EQUIVALENTS
C
C             if an equal sign apperars as th first character
C             change it in to a blank.
C
      IF( CNL( 1:1 ) .EQ. '=' ) CNL( 1: 1 ) = ' '
      READ(UNIT=CNL, FMT=100, IOSTAT=FOR_RETCODE, ERR=110) NP
100   FORMAT(I5)
      READ(UNIT=CFF, FMT=100, IOSTAT=FOR_RETCODE, ERR=110) IMIN
      READ(UNIT=CINC, FMT=100, IOSTAT=FOR_RETCODE, ERR=110) IINC
      FMIN=IMIN
      FINC=IINC
      RETURN
110   IF (FOR_RETCODE .EQ. 64) THEN               ! if input format error
              CALL LIB$SIGNAL(MAG_INPFOR)         !    PRINT ERROR
              EFLAG = .TRUE.                      ! flag an error
      ELSE
              CALL LIB$SIGNAL(MAG_COM)            ! else some other error
              EFLAG = .TRUE.                      ! flag error
      END IF
      RETURN
      END
```

```
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
CC
CC                    FORT
CC              FOURIER TRANSFORM
CC
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
C
      SUBROUTINE FORT(A,M,S,IFS,IFERR)                                  FORT 001
      DIMENSION A(1),S(1),K(15)
      IF(M)2,2,3                                                        FORT 056
    3 IF(M-14) 5,5,2
    2 IFERR=1                                                           FORT 058
    1 RETURN                                                            FORT 059
    5 IFERR=0                                                           FORT 060
      N=2**M                                                            FORT 061
      IF( IABS(IFS) - 1 ) 200,200,10                                    FORT 062
C     WE ARE DOING TRANSFORM ONLY. SEE IF PRE-COMPUTED                  FORT 063
C     S TABLE IS SUFFICIENTLY LARGE                                     FORT 064
   10 IF( N-NP )20,20,12                                                FORT 065
   12 IFERR=1                                                           FORT 066
      GO TO 200                                                         FORT 067
C     SCRAMBLE A, BY SANDE'S METHOD                                     FORT 068
   20 K(1)=2*N                                                          FORT 069
      DO 22 L=2,M                                                       FORT 070
   22 K(L)=K(L-1)/2                                                     FORT 071
      DO 24 L=M,13
   24 K(L+1)=2                                                          FORT 073
C     BINARY SORT-                                                      FORT 075
      K1=K(14)
      K2=K(13)
      K3=K(12)
      K4=K(11)
      K5=K(10)
      K6=K(9)
      K7=K(8)
      K8=K(7)
      K9=K(6)
      K10=K(5)
      K11=K(4)
      K12=K(3)
      K13=K(2)
      K14=K(1)
      N2=K(1)
      IJ=2                                                              FORT 076
      DO 30 J1=2,K1,2                                                   FORT 077
      DO 30 J2=J1,K2,K1                                                 FORT 078
      DO 30 J3=J2,K3,K2                                                 FORT 079
      DO 30 J4=J3,K4,K3                                                 FORT 080
      DO 30 J5=J4,K5,K4                                                 FORT 081
      DO 30 J6=J5,K6,K5                                                 FORT 082
      DO 30 J7=J6,K7,K6                                                 FORT 083
      DO 30 J8=J7,K8,K7                                                 FORT 084
      DO 30 J9=J8,K9,K8                                                 FORT 085
      DO 30 J10=J9,K10,K9                                               FORT 086
      DO 30 J11=J10,K11,K10                                             FORT 087
      DO 30 J12=J11,K12,K11                                             FORT 088
      DO 30 J13=J12,K13,K12
      DO 30 JI=J13,K14,K13
      IF(IJ-JI)28,30,30                                                 FORT 090
   28 T=A(IJ-1 )                                                        FORT 091
      A(IJ-1)=A(JI-1)                                                   FORT 092
      A(JI-1)=T                                                         FORT 093
      T=A(IJ)                                                           FORT 094
      A(IJ)=A(JI)                                                       FORT 095
      A(JI)=T                                                           FORT 096
```

AD-A191 847 CIMAG2: THE COMPUTER PROGRAM TO GENERATE COLOR IMAGES 2/2
(U) OHIO STATE UNIV COLUMBUS ELECTROSCIENCE LAB
G DURAL ET AL NOV 87 ESL-718048-7 N00014-86-K-0202

UNCLASSIFIED F/G 12/5 NL


1.0
2.8
2.5
3.2
2.2
3.6
4.0
2.0
1.1
1.8
1.25
1.4
1.6

```
   30 IJ=IJ+2
      IF(IFS)32,2,36
C     DOING FOURIER ANALYSIS,SO DIV. BY N AND CONJUGATE.
   32 FN = N
      DO 34 I=1,N
      A(2*I-1) = A(2*I-1)/FN
   34 A(2*I)=-A(2*I)/FN
C     SPECIAL CASE- L=1
   36 DO 40 I=1,N,2
      T = A(2*I-1)
      A(2*I-1) =T + A(2*I+1)
      A(2*I+1)=T-A(2*I+1)
      T=A(2*I)
      A(2*I) = T + A(2*I+2)
   40 A(2*I+2)= T - A(2*I+2)
      IF(M-1) 2,1  ,50
C     SET FOR L=2
   50 LEXP1=2
C     LEXP1=2**(L-1)
      LEXP=8
C     LEXP=2**(L+1)
      NPL= 2**MT
C     NPL = NP* 2**-L
   60 DO 130 L=2,M
C     SPECIAL CASE- J=0
      DO 80 I=2,N2,LEXP
      I1=I + LEXP1
      I2=I1+ LEXP1
      I3 =I2+LEXP1
      T=A(I-1)
      A(I-1) = T +A(I2-1)
      A(I2-1) = T-A(I2-1)
      T =A(I)
      A(I) = T+A(I2)
      A(I2) = T-A(I2)
      T= -A(I3)
      TI = A(I3-1)
      A(I3-1) = A(I1-1) - T
      A(I3   ) = A(I1 )    - TI
      A(I1-1) = A(I1-1) +T
   80 A(I1)    = A(I1    )   +TI
      IF(L-2) 120,120,90
   90 KLAST=N2-LEXP
      JJ=NPL
      DO 110 J=4,LEXP1,2
      NPJJ=NT-JJ
      UR=S(NPJJ)
      UI=S(JJ)
      ILAST=J+KLAST
      DO 100 I= J,ILAST,LEXP
      I1=I+LEXP1
      I2=I1+LEXP1
      I3=I2+LEXP1
      T=A(I2-1)*UR-A(I2)*UI
      TI=A(I2-1)*UI+A(I2)*UR
      A(I2-1)=A(I-1)-T
      A(I2  )=A(I    ) - TI
      A(I-1) =A(I-1)+T
      A(I)    =A(I)+TI
      T=-A(I3-1)*UI-A(I3)*UR
      TI=A(I3-1)*UR-A(I3)*UI
      A(I3-1)=A(I1-1)-T
      A(I3)    =A(I1   )-TI
      A(I1-1)=A(I1-1)+T
  100 A(I1)    =A(I1)    +TI
C     END OF I LOOP
```

```
  110 JJ=JJ+NPL
C     END OF J LOOP
  120 LEXP1=2*LEXP1
      LEXP = 2*LEXP
  130 NPL=NPL/2
C     END OF L LOOP
  140 IF(IFS)145,2,1
C     DOING FOURIER ANALYSIS. REPLACE A BY CONJUGATE.
  145 DO 150 I=1,N
  150 A(2*I) =-A(2*I)
  160 GO TO 1
C     RETURN
C     MAKE TABLE OF S(J)=SIN(2*PI*J/NP),J=1,2,....NT-1,NT=NP/4
  200 NP=N
      MP=M
      NT=N/4
      MT=M-2
      IF(MT) 260,260,205
  205 THETA=.7853981634
C     THETA=PI/2**(L+1)    FOR L=1
  210 JSTEP = NT
C     JSTEP = 2**( MT-L+1 ) FOR L=1
      JDIF = NT/2
C     JDIF = 2**(MT-L)  FOR L=1
      S(JDIF) = SIN(THETA)
      IF (MT-2)260,220,220
  220 DO 250 L=2,MT
      THETA = THETA/2.
      JSTEP2 = JSTEP
      JSTEP = JDIF
      JDIF = JDIF/2
      S(JDIF)=SIN(THETA)
      JC1=NT-JDIF
      S(JC1)=COS(THETA)
      JLAST=NT-JSTEP2
      IF(JLAST-JSTEP)250,230,230
  230 DO 240 J=JSTEP,JLAST,JSTEP
      JC=NT-J
      JD=J+JDIF
  240 S(JD)=S(J)*S(JC1)+S(JDIF)*S(JC)
  250 CONTINUE
  260 IF(IFS)20,1,20
      END
```

```
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
CC
CC                       DDMPB
CC           BASIC SCATTERING CODE READ ROUTINE
CC
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
CC
        SUBROUTINE BSCREA(P,COM_UNIT)
        COMPLEX ET(1024),EP(1024)
        REAL P(4096,9),DT(1024),DP(1024)
        CHARACTER*20 INFILE
        INTEGER*4 COM_UNIT
        INCLUDE 'SYS$LIBRARY:FORIOSDEF'
        PI=3.14159265
810     TYPE *,' INPUT FILE NAME = '
        READ (COM_UNIT,7823) INFILE
7823    FORMAT(A20)
        OPEN(UNIT=19,NAME=INFILE,STATUS='OLD',FORM='UNFORMATTED'
        2,IOSTAT=IERR,ERR=8100)
        DO 3410 I=1,2048
        P(I+2048,1)=0.
3410    P(I,1)=-1024.
        READ(19) ET
        READ(19) EP
        READ(19) IB,IE,IS,PLS,PLI
        FAC=10.*BLOG10(4.*PI)
        DO 40 I=IB,IE,IS
        DT(I)=20.*BLOG10(BABS(ET(I)))+FAC
40      DP(I)=20.*BLOG10(BABS(EP(I)))+FAC
        ETM=-200.
        EPM=-200.
        ETA=0.
        EPA=0.
        IT=0
        DO 11 I=IB,IE,IS
        IF(DT(I).GT.ETM) ETM=DT(I)
        IF(DP(I).GT.EPM) EPM=DP(I)
        IT=IT+1
        ETA=ETA+DT(I)
        EPA=EPA+DP(I)
11      CONTINUE
        ETA=ETA/IT
        EPA=EPA/IT
        PLE=PLS+(IE-1)*PLI
        TYPE 1,PLS,PLE,PLI
1       FORMAT(' START= ',F10.5,5X,'END= ',F10.5,5X,'STEP= ',F10.5)
        TYPE 3,ETM,EPM
3       FORMAT(' ETM= ',F10.5,5X,'EPM= ',F10.5)
        TYPE 2,ETA,EPA
2       FORMAT(' ETA= ',F10.5,5X,'EPA= ',F10.5)
        TYPE 4
4       FORMAT(' ET=1, EP=2, IPOL= ',$)
        READ (COM_UNIT,*) IPOL
        DLE=0.03/(2.*PI*PLI)
        TYPE *,' L= ',DLE
        TYPE *,'NORMALIZE TO: SQ CM(1), SQ M(2), PI*L*L/4(0)?'
        READ (COM_UNIT,*) INORM
        DFAC=0.
        IF(INORM.EQ.0) DFAC=-10.*BLOG10(0.25*PI*DLE*DLE)
        IF(INORM.EQ.1) DFAC=20.
        KLOW=1.5+PLS/PLI
        DO 7720 I=IB,IE,IS
        K=KLOW+I-1
        IF(IPOL.EQ.1) THEN
        P(K,1)=10.24*(10.+DFAC+DT(I))
        P(K+2048,1)=512.*BTAN2(AIMAG(ET(I)),REAL(ET(I)))/PI
```

```
        ELSE
        P(K,1)=10.24*(10.+DFAC+DP(I))
        P(K+2048,1)=512.*BTAN2(AIMAG(EP(I)),REAL(EP(I)))/PI
        ENDIF
7720    CONTINUE
        GO TO 80
8100    IF(IERR.EQ.FOR$IOS_FILNOTFOU)THEN
        TYPE 1112,INFILE
1112    FORMAT(' FILE : ',A20,' DOES NOT EXIST',//
        2,' ENTER FILENAME AGAIN')
        ELSE IF (IERR.EQ.FOR$IOS_FILNAMSPE)THEN
        TYPE *,'FILE:',INFILE,'WAS BAD,     ENTER NEW FILENAME'
        ELSE
        TYPE *,'UNRECOVERABLE ERROR , CODE =',IERR
        STOP
        ENDIF
        GO TO 810
80      CLOSE(UNIT=19,DISP='SAVE')
        RETURN
        END
        INCLUDE 'ESL_ESLROOT:[GRP11LIB]BFILES.FOR'
```

```
cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc
cc
cc              CIMAGMSG
cc      PROGRAM ERROR MESSAGES
cc
cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc
cc
cc

.TITLE          CIMAG_MESSAGES  Program error messages   ! module name and
C                                                        listing title
.FACILITY       CIMAG,283/PREFIX=MAG_
!
!
! Error Messages
.SEVERITY       ERROR
COM             "error in command"
INPFOR          "error in input format"
FILNOTFOU       "file not found in this directory"
.END
```

APPENDIX D

COLOR IMAGING PROGRAM CLRPL

```
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
CC                                                             CC
CC                            CLRPL                            CC
CC                                                             CC
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
C
C
C       THIS PROGRAM DEFINES A PLOTTING SOFTWARE CODE TO PLOT
C       IMAGE OF AN OBJECT WITH POLARIZATION INFORMATION
C
C       IMAGE DATA SHOULD BE CODED BY A 100*100 MATRIX AND
C       IT SHOULD BE CONTAINED IN THE MATRIX 'ARRAY(100,100)'

        DIMENSION ICOL(100,100),ICOLA(100)
        DIMENSION GX(5),GY(5),CBX(5),CBY(5),XP(5),YP(5),XT(10),YT(10)
        DIMENSION ARRAY(100,100),COORD(5)
        INTEGER COLI,WKSTID
        REAL*4 L
        LOGICAL FINISHED
        CHARACTER*40 FILNM
        CHARACTER*7 NUMB

C       THE GX MATRIX IS THE X COORDINATES OF THE COLOR GRID
        DATA GX/.30,.85,.85,.30,.30/

C       THE GY MATRIX IS THE Y COORDINATES OF THE COLOR GRID
        DATA GY/.12,.12,.67,.67,.12/

C       THE CBX MATRIX IS THE X COORDINATES OF THE COLOR BOX
        DATA CBX/.30,.85,.85,.30,.30/

C       THE CBY MATRIX IS THE Y COORDINATES OF THE COLOR BOX
        DATA CBY/.70,.70,.72,.72,.70/

C       THE XT MATRIX IS THE X COORDINATES OF THE TIK MARKS
        DATA XT/.3,.44,.57,.71,.85,.26,.26,.26,.26,.26/

C       THE YT MATRIX IS THE Y COORDINATES OF THE TIK MARKS ON THE Y AXIS
        DATA YT/.08,.08,.08,.08,.08,.12,.26,.40,.54,.67/


        PI=4.*ATAN(1.)
        KWK=412505
        WKSTID=1

C
C       YMTCL--Y Value of Magnitude Top Center Line
        YMTCL=CBY(3)+.02
C
C       ENTER THE ARRAY TO BE PLOTTED
        WRITE(6,*)'ENTER FILE NAME'
        READ(5,100) FILNM
100     FORMAT(A40)
C
C
C       POLARIZATION DEPENDENT PLOT?
        WRITE(6,*) 'DO YOU NEED TO USE POLARIZATION AS A PARAMETER?'
        WRITE(6,*)'(Y=1 N=0)'
        READ(5,*) POL
        IF(POL.EQ.1) THEN
C       ENTER THE POLARIZATION
        WRITE(6,*)'ENTER POLARIZATION (VP=1,HP=2)'
        READ(5,*) PL
```

```
      ELSE
      END IF
C
      OPEN(UNIT=1,FILE=FILNM,STATUS='OLD',FORM='UNFORMATTED')
C
C     ENTER THE IMAGE SIZE AND PERIOD OF THE TIME SIGNAL
      READ(1) IMGSZ,PER
C
C     ENTER THE IMAGE ARRAY

      DO 1000 I=1,100
      DO 1000 J=1,100
      READ(1)ARRAY(I,J)
      ARRAY(I,J)=ABS(ARRAY(I,J))
1000  CONTINUE
C

C     NORMALIZE THE ARRAY VALUES
C
      CALL SEARCH(ARRAY,AMAX,AMIN)
      WRITE(6,*)'MAX=',AMAX,'MIN=',AMIN
      WRITE(6,*)'ENTER THE DESIRED MAX.,AND,MIN.'
      READ(5,*) ANMAX,ANMIN
      DO 20 I=1,100
      DO 20 J=1,100
      IF (ARRAY(I,J).GT.ANMAX) ARRAY(I,J)=ANMAX
      IF (ARRAY(I,J).LT.ANMIN) ARRAY(I,J)=ANMIN
      ARRAY(I,J)=(ARRAY(I,J)-ANMIN)/(ANMAX-ANMIN)
20    CONTINUE
C
C     OPEN GKS ERROR FILE
      CALL GOPKS(6,5000)

C     FIND CONNECT ID
999   CALL GKHGCI('ESL_4129',JERROR,KCONID)
      IF(JERROR.NE.0) THEN
      WRITE(6,*) 'Can not be a connection ID'
      WRITE(6,*) 'Would you like to wait ? (Y=1)'
      READ(5,*)ANS
      IF(ANS.NE.1) THEN
         STOP
         ELSE
          WRITE(6,*) 'Enter 1 when ready'
          READ(5,*) ANS
          GO TC 999
      END IF
      END IF
C     OPEN WORKSTATON #1
      CALL GOPWK(1,KCONID,KWK)

C     ACTIVATE WORKSTATION #1
      CALL GACWK(1)

C     SET THE WORKSTATION WINDOW/VIEWPORT-FULLSCREEN
C     GET MAX X AND Y
      KUNITS=0
      CALL GQDSP(KWK,KERROR,KUNITS,XSIZE,YSIZE,KRASX,KRASY)
      CALL GSWKWN(1,0.,1.,0.,YSIZE/XSIZE)
      CALL GSWKVP(1,0.,.343,0.,.274)

C     GENERATE THE COLOR INDICES
C
    IF(POL.EQ.0) THEN
      DO 3 COLI=1,100
             L=.5
             S=1
```

```
              IF(COLI.LE.5)L=0
              H=95+2.6*COLI
              CALL HLSRGB(H,L,S,R,G,B)
              CALL GSCR(1,1+COLI,R,G,B)
              ICOLA(COLI)=1+COLI
3       CONTINUE
              ELSE
             DO 4 COLI=1,100
              L=.5
              S=1
              FC=25*(4.8)**(COLI/100.)
              IF(COLI.LE.5) L=0
              IF(PL.EQ.1) H=225-FC
              IF(PL.EQ.2)H=110-FC
              IF(PL.EQ.2.AND.COLI.LT.25.AND.COLI.GT.5)L=.75
              IF(H.LT.0) H=H+360
              CALL HLSRGB(H,L,S,R,G,B)
              CALL GSCR(1,1+COLI,R,G,B)
              ICOLA(COLI)=1+COLI
4       CONTINUE
        END IF
C
C       GENERATE COLOR CODE FOR X AND Y COORDINATED RCS LEVELS
        DO 30 I=1,100
           DO 30 J=1,100
             ICOL(I,J)=ARRAY(I,J)*99+2
30      CONTINUE

C       PLOT COLOR LABEL USING CELL ARRAY
        CALL GCRSG(SEG)
        CALL GCA(CBX(1),CBY(1),CBX(3),CBY(3),100,1,1,1,100,1,ICOLA)
        CALL GSPLCI(1)
        CALL GPL(5,CBX,CBY)
C

C       LABEL COLOR BAR
        CALL GSTXAL(2,3)
        CALL GSTXP(0)
        CALL GSCHXP(1.25)
        CALL GSCHSP(1.)
            CALL GTX(GX(1),YMTCL,'0.0')
            CALL GTX(.44,YMTCL,'0.25')
            CALL GTX(.57,YMTCL,'0.50')
            CALL GTX(.71,YMTCL,'0.75')
            CALL GTX(GX(2),YMTCL,'1.0')
            CALL GSCHXP(1.)
            CALL GSCHSP(1.)

C       PLOT COLOR MATIX USING CELL ARRAY
        TEST=10
        IF (TEST.EQ.0)GO TO 21
        CALL GCA(GX(1),GY(1),GX(3),GY(3),100,100,1,1,100,100,ICOL)
        CALL GSPLCI(1)
        CALL GPL(5,GX,GY)
C
C       DRAW GRID LINE ADJACENT TO EACH AXES

        XP(1)=.30
        XP(2)=.85
        YP(1)=.08
        YP(2)=.08
        CALL GPL(2,XP,YP)
        XP(1)=.26
        XP(2)=.26
        YP(1)=.12
        YP(2)=.67
```

```
      CALL GPL(2,XP,YP)
C     PRINT THE TIK MARKS
      CALL GSMK(2)
      CALL GSMKSC(1)
      CALL GSPMCI(1)
      CALL GPM(10,XT,YT)
C
C     SHOW THE ASPECT ANGLES
      XP(1)=.57
      XP(2)=.57
      YP(1)=.16
      YP(2)=.19
      CALL GPL(2,XP,YP)
      XP(1)=.565
      XP(2)=.57
      XP(3)=.575
      YP(1)=.185
      YP(2)=.19
      YP(3)=.185
      CALL GPL(3,XP,YP)
      XP(1)=.80
      XP(2)=.77
      YP(1)=.40
      YP(2)=.40
      CALL GPL(2,XP,YP)
      XP(1)=.775
      XP(2)=.77
      XP(3)=.775
      YP(1)=.405
      YP(2)=.4
      YP(3)=.395
      CALL GPL(3,XP,YP)
      CALL GTX(.57,.14,'0 DEG.')
      CALL GTX(.57,.02,'TIME IN NANOSECONDS')
      CALL GSTXAL(2,1)
      CALL GSTXP(0)
      CALL GSCHUP(1.,0.)
      CALL GTX(.82,.4,'90 DEG.')
      CALL GTX(.20,.40,'TIME IN NANOSECONDS')
C
C     FIGURE OUT THE COORDINATES ON EACH AXES
      CALL MARKS(IMGSZ,PER,COORD)
C
C     PRINT THE COORDINATES
      X=.30
      CALL GSCHUP(0.,1.)
      DO 40 I=1,5
      WRITE(NUMB,FMT='(F6.2)')COORD(I)
      CALL GTX(X,.06,NUMB)
40    X=X+.14
      CALL GSCHUP(1.,0.)
      Y=.12
      DO 50 I=1,5
      WRITE(NUMB,FMT='(F5.2)')COORD(I)
      CALL GTX(.23,Y,NUMB)
50    Y=Y+.14
C
C
C     COLOR 1 = WHITE, 0 = BLACK (ON PLOTTER, REVERSED ON SCREEN)
C
21    CALL GCLSG(SEG)
C
      WRITE(6,*)'Enter return to finish......'
      READ(5,1)FINISHED
```

```
1       FORMAT(A1)
        CALL GCLRWK(WKSTID,1)            !Clears the screen on TEXTRONIX

C       DEACTIVATE THE WORK STATION
        CALL GDAWK(1)
C
C       CLOSE THE WORK STATION
        CALL GCLWK(1)

C       CLOSE THE SYSTEM
        CALL GCLKS
        STOP
        END


CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
CC      THIS ROUTINE MAKES THE TRANSFORMATION BETWEEN COLOR SYSTEMS
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
        SUBROUTINE HLSRGB(H,L,S,R,G,B)
        REAL H,L,S,R,G,B,M1,M2
        IF (L .LE. .5) THEN
          M2=L*(1+S)
        ELSE
          M2=L+S-L*S
8       END IF
        M1=2*L-M2
        B=rgb_value(M1,M2,H+120)
        R=rgb_value(M1,M2,H)
        G=rgb_value(M1,M2,H-120)
        RETURN
        END


        FUNCTION rgb_value(N1,N2,HUE)
        REAL    rgb_value,N1,N2,HUE
        IF (HUE .GT. 360) THEN
          HUE=HUE-360
        END IF
        IF (HUE .LT. 0) THEN
          HUE=HUE+360
        END IF
        IF (HUE .LT. 60) THEN
          rgb_value=N1+(N2-N1)*HUE/60
        ELSE IF (HUE .LT. 180) THEN
          rgb_value=N2
        ELSE IF (HUE .LT. 240) THEN
          rgb_value=N1+(N2-N1)*(240-HUE)/60
        ELSE
          rgb_value=N1
        END IF
        RETURN
        END

CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C       THIS ROUTINE FINDS THE MAX., AND MIN. OF A 100*100 ARRAY
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
C

        SUBROUTINE SEARCH(ARRAY,AMAX,AMIN)
        DIMENSION ARRAY(100,100)
        AMAX=-1000
        AMIN=1000
        DO 1 I=1,100
            DO 1 J=1,100
```

```
                IF(ARRAY(I,J).GT.AMAX)AMAX=ARRAY(I,J)
                IF(ARRAY(I,J).LT.AMIN)AMIN=ARRAY(I,J)
1       CONTINUE
        RETURN
        END

CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C       THIS ROUTINE CALCULATES THE DIVISIONS ON THE AXES
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
C
        SUBROUTINE MARKS(IMGSZ,PER,COORD)
        DIMENSION COORD(5)
        SIZE=PER*IMGSZ/4096.
        COORD(1)=SIZE/-2.
        COORD(2)=SIZE/-4.
        COORD(3)=0
        COORD(4)=SIZE/4.
        COORD(5)=SIZE/2.
        RETURN
        END
```

END
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